Chemical Age

CAUSES OF WINDSCALE ACCIDENT
(page 801)

VOL. 78 No. 2001

16 November 1957

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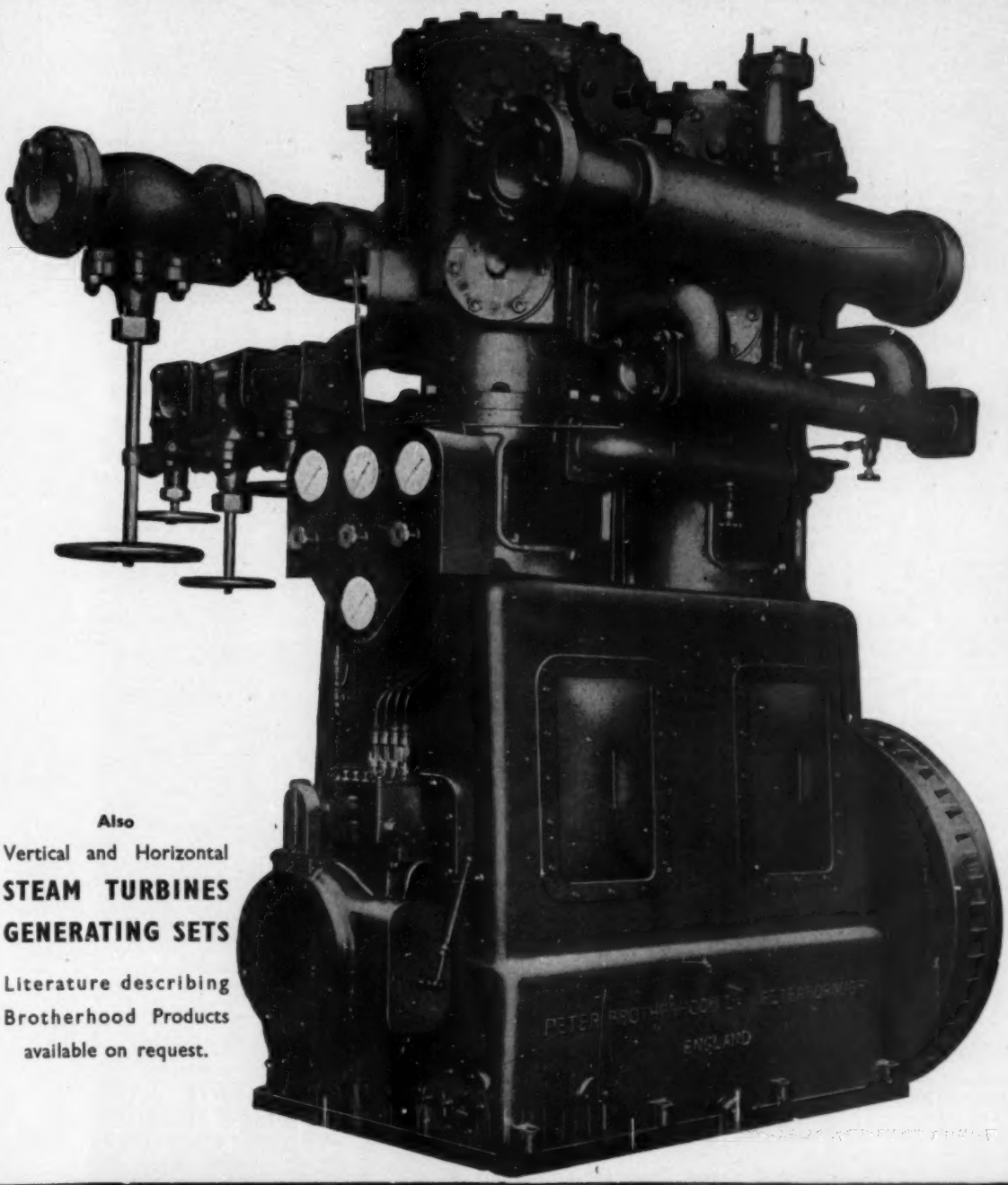

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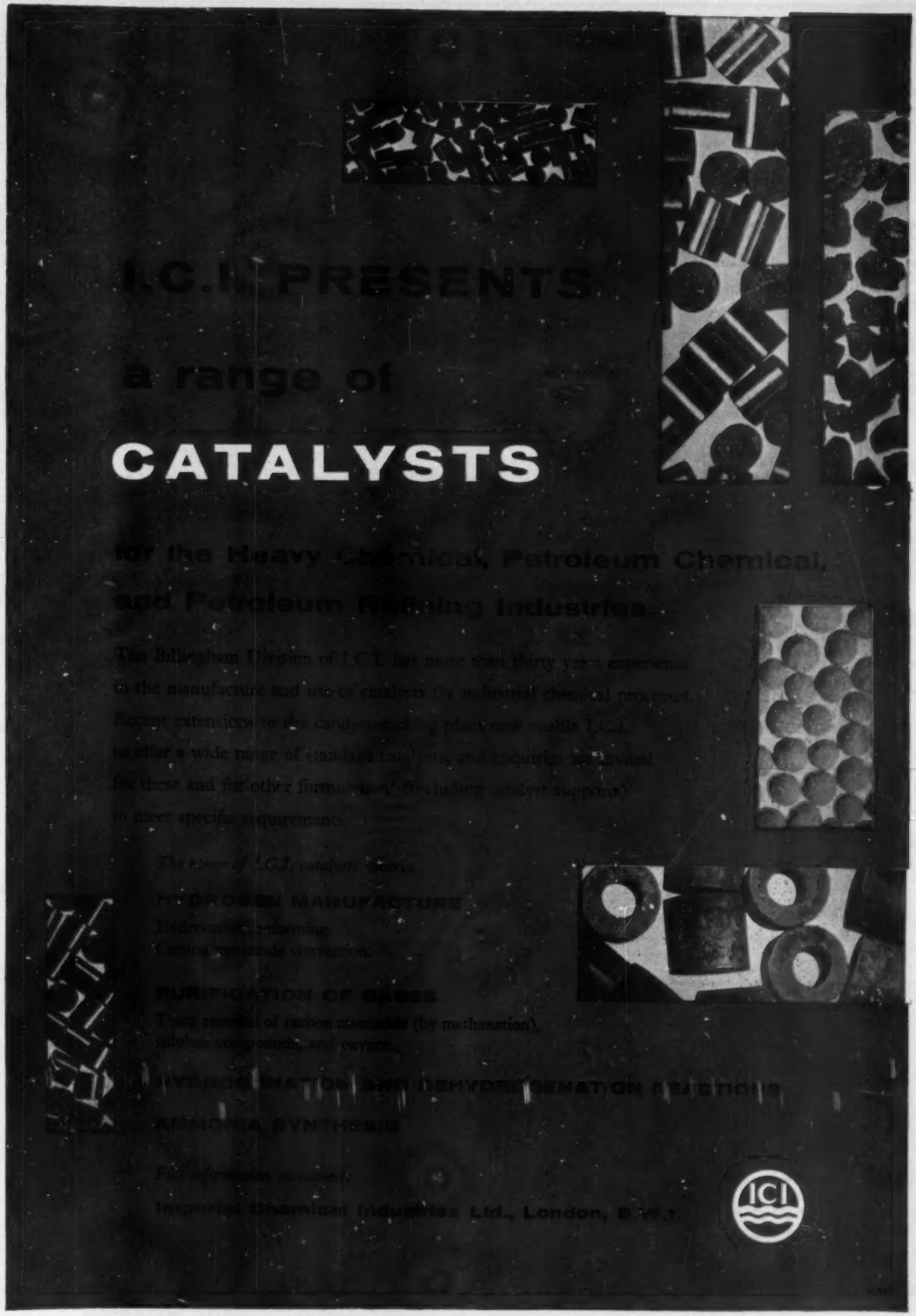
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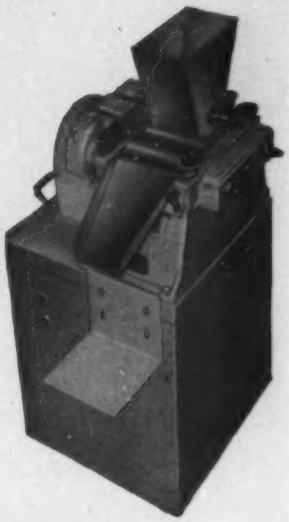

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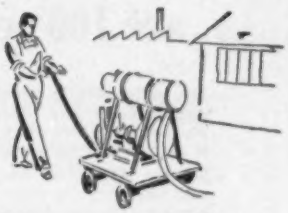

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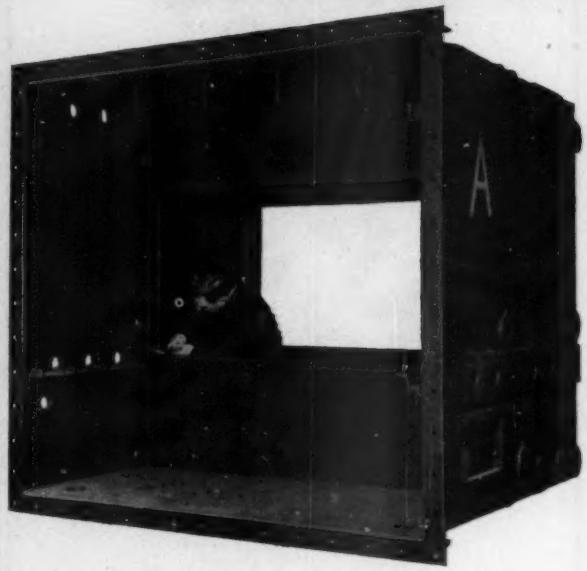

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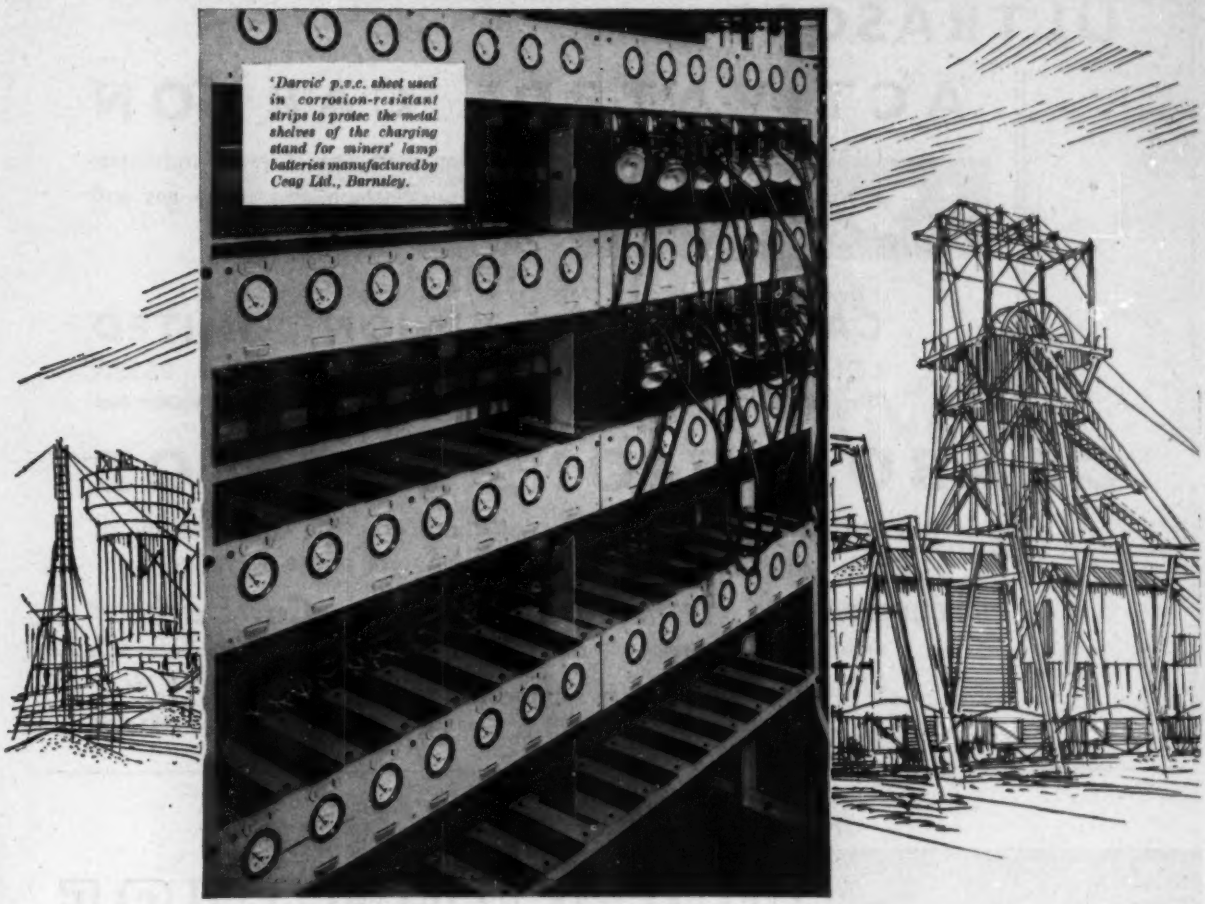

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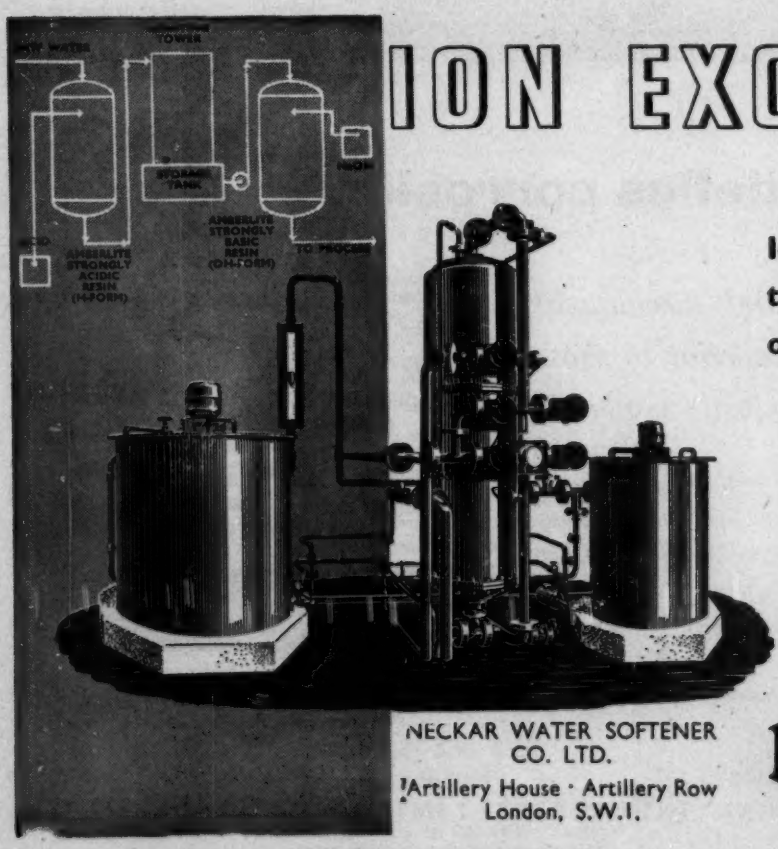

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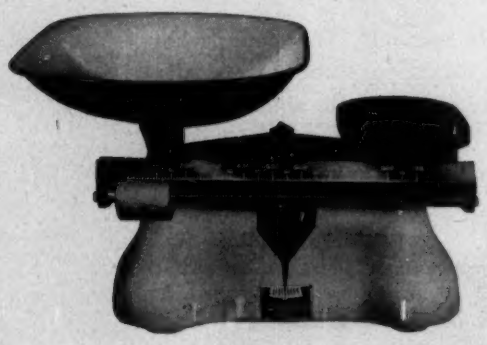

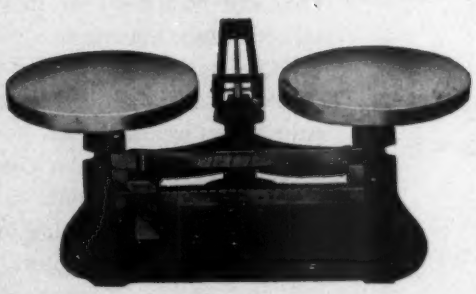

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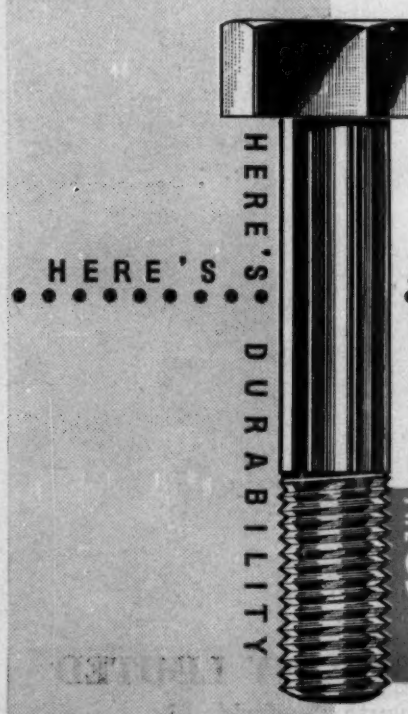

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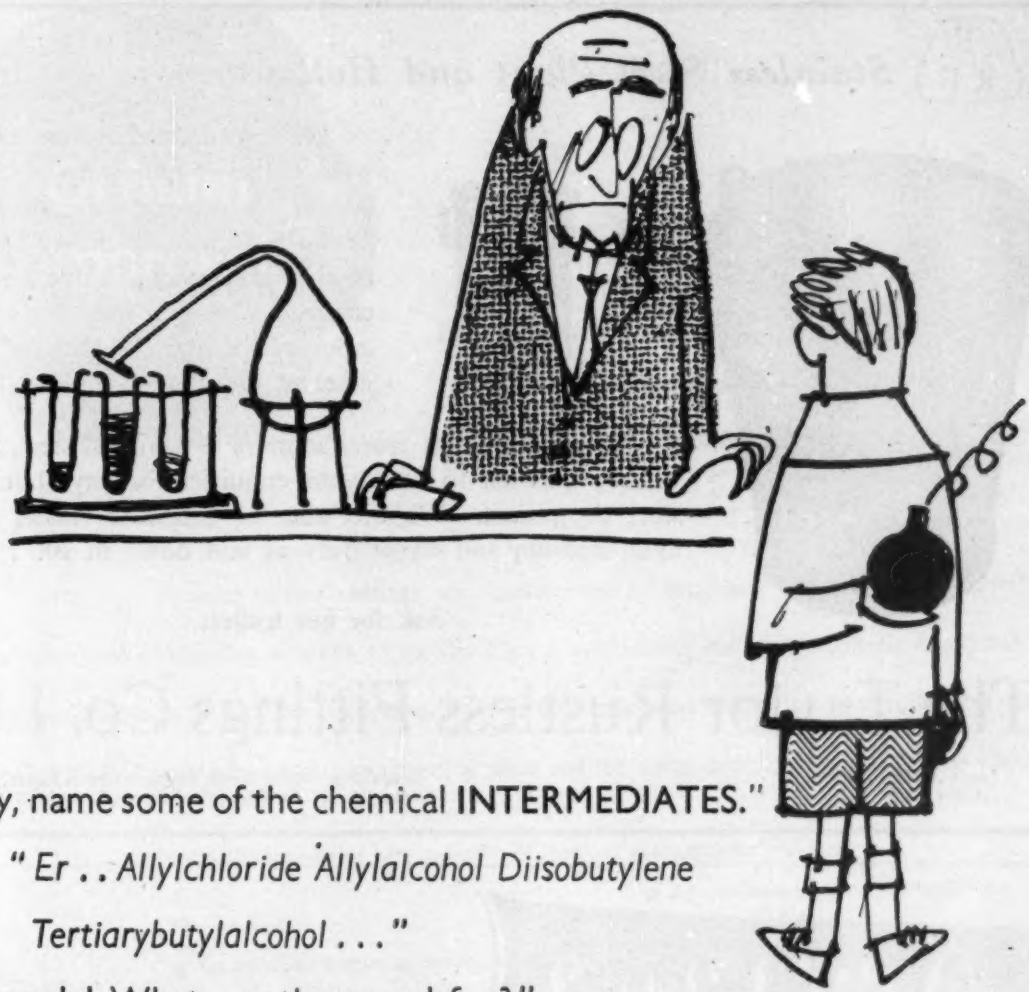

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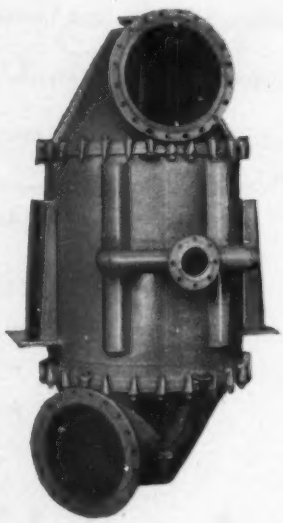

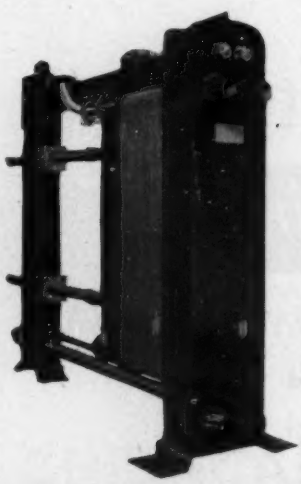

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WINDSCALE POST-MORTEM

ATOMIC PLANTS have been regarded as the epitome of modernity and of efficiency and staffed by the cream of scientists. The White Paper published last Friday (see P. 801) makes it very plain that the UK Atomic Energy Authority has been at fault regarding Windscale. Sir Edwin Plowden, chairman of UK AEA, said that 'human error' had led to the Windscale accident, one which has involved some £ millions.

Study of the White Paper is very disturbing. The cause of the Windscale accident will never definitely be known, but inadequacies in instrumentation, the fact that the physicist in charge 'had no Pile Operating Manual, with special sections on Wigner release, to help him, nor had he the benefit of sufficiently detailed instructions,' that at a critical time, the scanner, which had on more than one previous occasion jammed, again jammed, have all contributed; and the authority cannot make any excuse.

It is realised that the plant is an old one, but that it should today have instruments which seven years ago were 'adequate' is hard to understand. It is admitted in the report that the instruments installed were not sufficient to provide the man in charge with sufficient data from which he could judge what was happening. To have checked on the behaviour of the release, records would have had to be obtained.

All this is particularly surprising, for in May, 1956, there was a similar, though very much less serious, accident at Windscale. It should have been realised at that time that the instrumentation was inadequate and steps should have been taken then. It was known, for instance, that at the end of previous Wigner releases the scanning gear, although not considered by the committee of inquiry of marked importance in operating the Wigner release, could not be moved, presumably because of overheating. On this present occasion it again failed, and at a time when this equipment might have been of assistance in locating the site of the burning fuel elements.

Sir Leonard Owen, managing director of the AEA industrial group, said that these facts had been reported to his headquarters at Risley. Questioned about this, he said that it would have been difficult to replace the equipment because it was inside the pile. On this point the committee of inquiry makes no comment, but it must be considered most disturbing that the difficult Wigner release should have been allowed when equipment had been shown to be faulty.

The original report presented by Sir William Penney's committee was a very technical document. As it dealt with the design and operation of a defence installation and presupposed considerable knowledge of the technology of this particular pile, it has not been considered to be in the national interests to publish it. The present White Paper is therefore a less technical version of the cause of the accident.

For instance, it is not revealed how much power the pile had released as this gives an immediate figure for plutonium made in the pile. Details of exact loading of the pile are not given and there is no statement regarding the length of time the rods had been in the pile. Especially, no information is given regarding the temperatures reached in various parts of the pile, as this is not deemed to be necessary in understanding how the accident

occurred. On this last point, however, it must be mentioned that one leading US chemical weekly quotes 'AEA sources' as saying that 'they are now absolutely certain of an academic breakthrough in the fusion field' and further that the temperatures produced were probably 'close to two million degrees centigrade—although the official figure is one million degrees.'

The report shows that cartridges of a lithium-magnesium alloy were being irradiated in the pile as part of the military production programme—'it was not an experiment.' The committee of enquiry has considered the likelihood that the presence of these cartridges may have started the accident, but discount this in favour of the uranium cartridges.

Questioned repeatedly about the Li-Mg cartridges, Sir William Penney evaded answering, insisting that the reactor was a military one. But it is well known that lithium is a source of tritium—a super-heavy hydrogen isotope used in hydrogen bombs and in experiments to harness peaceful fusion energy. Also it is known that tritium has been produced in Windscale No. 1 reactor by a method which is known to have been tried out in detail for a relatively short period. Hence, presumably the statement 'it was not an experiment' in the report.

Sir John Cockcroft has recently said that encouraging results have been obtained in the authority's experiments with atomic fusion. In the tests, the Zeta apparatus has produced temperatures of well over a million degrees and maintained them for thousandths of a second, rather than millionths as previously. This has been enough to produce fusion of deuterium and tritium in a tube.

World attention has been focussed on the Windscale accident, as it is the most serious one yet, because of the contamination of a large area of surrounding countryside. It is therefore reassuring to learn from the Medical Research Council's investigations that it is 'in the highest degree unlikely' that harm has been done to the health of anybody whether a worker in Windscale or a member of the general public. Also that in spite of the shortcomings shown up by the report, the measures adopted were essentially right and when implemented were adequate to prevent ill effects.

In another annex to the report AEA gives reasons why the accident which occurred at Windscale could not happen with the Calder Hall reactors or with the reactors being built for the electricity authorities. It is stated that Wigner annealing will be required much less frequently at the new plants—perhaps only once every five years. It is added that this annealing process 'will not present any hazard' for the following reasons: The new reactors use carbon dioxide as coolant, which does not react with uranium until the temperature is greater than 650°C. (Air used at Windscale for cooling can react with uranium at 350°C). The new reactors will use carbon dioxide circulating in a closed circuit for cooling, so that there will be no discharge into the atmosphere. There are 'superior' arrangements for detecting burst fuel elements.

During the last 15 years seven accidents to reactors have been reported, with some three or four breakdowns. Of the seven accidents only details concerning five are known. The first occurred in 1952, when the Canadian NRX experimental reactor 'ran away' during an experiment. This was due to a mixture of human and mechanical errors. However, nobody was injured and there was no exposure to radioactivity.

In 1955, at the breeder reactor at Arco, Idaho, US, EBR-1, where highly enriched uranium was being fissioned, the wrong button was pressed when the reactor was to be shut down, with the result that fissioning went out of control. Radioactive material was released but confined to the reactor building.

An accident similar to the Windscale one occurred at the French Atomic Energy Commissariat at the Saclay centre in June last year. Casing enclosing a uranium fuel rod burst and released radioactive ash into the atmosphere.

Mechanical failure caused the 'Godiva,' US. experimental reactor to explode in February this year. It was known to be of potentially dangerous design and was, therefore, remotely controlled. Finally, the US Atomic Energy Commission purposely exploded Borax 1, another experimental reactor at Argonne, Idaho, by letting it 'run away.' Radioactive fallout was limited.

The UK AEA is to be complimented on reporting its shortcomings, and in recommending that its activities should be reviewed by an independent person. Sir Alexander Fleck, who has been chosen to head three committees (see P. 803), is to examine the data from Windscale Pile No. 1, and only after his reports, which may or may not be made known, will Windscale Pile No. 2 go into operation if the report is favourable. What will happen to the damaged reactor is not known at this stage, but it seems that it, too, must await the outcome of the Fleck reports.

US TARIFF PROBLEMS

IT is suggested that the US may have a new tariff policy next year, for in June of 1958 the Reciprocal Trade Agreements Act expires and debate in Congress regarding extending the law might result in a complete overhaul of US foreign trade policies.

On 2 December the House Subcommittee on Foreign Trade Policy is to hold hearings lasting two weeks on foreign trade, at which representatives of the US Government and industry will tell the committee what should be done.

Opinions submitted to the committee have just been released in a 1157-page 'compendium'. Both the US Manufacturing Chemists' Association (MCA) and the US Synthetic Organic Chemists' Manufacturers Association (SOCMA) have given their views on foreign trade and the chemical industry.

SOCMA has long been a supporter of high tariffs on chemicals and criticises the US Administration's way of handling foreign trade problems. The synthetic organic chemicals industry, it says, 'cannot continue to efficiently serve defence needs if the permanent programme of tariff reductions permits foreign makers to export low-cost organic chemicals to the United States and displace domestic, peacetime production of "bread and butter" items'.

In particular, it appears that SOCMA is annoyed with the General Agreement for Tariff and Trade, US membership of which is considered by the association not to be sanctioned by the provisions of the US and contrary to the intention of Congress. The association considers that future trade agreements should be negotiated by the US and other countries on a bilateral basis and not by GATT.

The Manufacturing Chemists' Association, while not decrying present US tariff policies, opposes sweeping changes —increases or reductions—in tariff rates. It believes that customs duties assessed on imports constitute the most effective way to offset differences in the cost of producing chemicals at home and abroad. It suggests that rates of duty should be established selectively on the basis of need and therefore, is in favour of setting tariffs on a product-by-product basis, and not on the basis of broad classes of products. MCA is calling for tariff protection for the 400 new products that are marketed each year in the US, for it suggests that lack of adequate tariff protection will tend to stifle research efforts and discourage further growth of US chemical industry. The MCA, in fact, does not disguise its fear of the rapid growth of foreign chemical industry.

According to reports in the US Press the US Executive Branch 'strongly favours continuation of the trade agreements legislation,' so that it is believed that the President will press for congressional approval of the US membership in the Organisation for Trade Cooperation, the proposed administrative branch of GATT.

CAUSES OF THE WINDSCALE ACCIDENT

Report Reveals Poor Instrumentation and Lack of Written Instructions

CAUSE of the Windscale accident is now known. In the White Paper issued last Friday, the report of the Committee of Enquiry headed by Sir William Penney, shows that the immediate cause of the accident was a second nuclear heating during a controlled release of stored Wigner energy from the graphite of the pile. This heating was applied before it was necessary and was put in at too rapid a rate.

It was this second heating which caused the failure of one or more cartridges of uranium fuel whose contents oxidised slowly, eventually leading to the fire.

A second possibility, which cannot be entirely eliminated, is that it was a lithium-magnesium cartridge which failed. There is also the suggestion that the second heating may have released pockets of Wigner energy at a time when the general level of temperatures throughout the pile was high.

Construction of the Windscale factory, which is a military plant, began in September 1947 and pile No. 1 came into operation in July 1950. When the plant was designed knowledge was scanty. In particular, there was no clear understanding regarding the phenomenon of the storage of energy in graphite due to neutron bombardment (the so-called Wigner energy). It was certainly not known in 1947 that such energy could be released spontaneously or by annealing.

The Wigner Release

In September 1952, a spontaneous release of Wigner energy occurred in the Windscale No. 1 pile, whilst the pile was shut down. This led to a rise of temperature of the graphite but the rise was not dangerous and there were no dangerous effects. As a result of a study of this incident, however, a procedure was instituted for controlling release of Wigner energy; and eight such releases had been carried out by the end of 1955 in pile No. 1. The general procedure was to shut down the pile, arrange the appropriate instrumentations and then cause the pile to diverge with no coolant airflow, thus raising the uranium and graphite temperatures and so starting the Wigner release in the graphite. The release is then self-sustaining.

Because it has been found difficult to release energy in all the graphite of the pile, on three previous occasions it had been found necessary to apply a second nuclear heating, sometime after the first heating. This was carried out when it was noted from the behaviour of the thermocouples in the graphite that the release of Wigner energy was coming to a halt before all the graphite had been annealed.

A sample of milk about to be analysed at the Windscale laboratories. The lead castle contains a scintillation counter and photomultiplier. Behind can be seen the amplifier, kick-sorter and pulse recorder

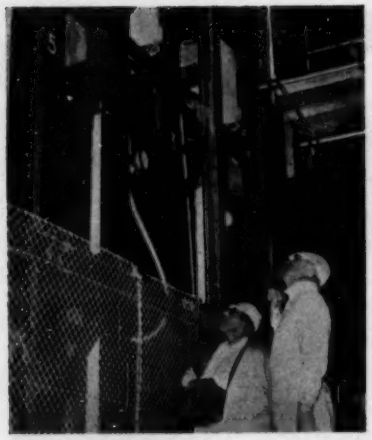
On the present occasion the pile was shut down at 1.13 p.m. on 7 October, and the main blowers were switched off. The Wigner release technique was started at 7.25 p.m. the same day, and nuclear heating stopped early the following morning. Some of the graphite temperatures showed falls but in some no Wigner release was noted. Acting on these observations, the physicist in charge decided to boost the release with a second nuclear heating. *He had no Pile Operating Manual, with special sections on Wigner release, to help him, nor had he the benefit of sufficiently detailed instructions.*

The pile diverged for the second nuclear heating at 11.05 a.m. on 8 October. The uranium thermocouples showed a temperature increase lasting for about 15 minutes after the pile diverged. The Committee of Enquiry studied the temperature time records and decided that the maximum rate of rise of temperature for a few minutes was several times greater than that which was permitted in normal operations. However, the maximum uranium temperature *recorded* did not exceed the maximum normal operating temperature.

When the rapid rate of rise of the uranium temperatures was noted, control rods were run in to reduce the pile power and thus allow the uranium fuel to cool somewhat. The Committee of Enquiry's opinion regarding this stage was that the damage leading to the accident had probably already occurred, and one or more uranium cartridges in the lower front part of the pile had failed.

Two separate and distinct faults of instrumentation affected the second nuclear heating. First, the uranium thermocouples were situated at the region of highest uranium temperatures during normal operations and were not at the position of maximum uranium temperatures during Wigner release. Because of this the pile operator was unaware that the uranium in the middle front regions of the pile was probably hotter than was indicated by the readings being taken and the rate of rise of temperature was greater than he was observing. A second deficiency of instrumentation was that the pile power meter, whilst correct for normal operations, read low in the situation prevailing.

Piecing together the evidence, the Committee conclude that as a result of the second nuclear heating, graphite temperatures gradually increased through 9 October. This led to oxidation of the uranium, which had been exposed by the overheating. The exposed uranium smouldered throughout 9 October and gradually led to the failure of other cartridges and their combustion, and to the combustion of graphite. By the evening of 10 October the fire had spread and was affecting about 150 channels. As one graphite temperature on 9 October had risen to such a value the pile physicist in charge was required by written instructions which he had, to take certain measures. At 10.15 p.m. the fan dampers were opened for 15 minutes to give a positive air flow through the pile. The dampers were opened again for short intervals first thing on 10 October until 5 a.m. This had a cooling effect on all graphite temperatures except the highest one, where the rise was merely arrested. At 5.40 a.m. the pile stack activity meter near the filter at the top of the stack showed a sharp increase. This was noted by the physicist in charge who considered it a normal consequence of first air



Examining the burst slug scanner gear inside No. 1 pile, Windscale

movement through the stack. From this time, too, until 8.10 a.m. falling readings were shown by the pile stack meter. After this, activity began to rise steadily, high activity being reported by noon.

During the morning of 10 October the graphite temperature started to rise again. The dampers were therefore opened again at 12.10 p.m. for 15 minutes and an hour later for five minutes. The pile stack meter showed a sharp increase. These effects suggested to the operating staff the existence of one or more burst cartridges. Attempts were then made to use the scanning gear to detect the bursts and it was found that the scanning gear had jammed and could not be moved, a finding which had occurred previously at the end of a Wigner release. Only on the previous day (9 October) the maintenance section had worked on the gear and had moved it.

The decision was taken to remove a charge plug in the charge wall in front of the pile and inspect the channel showing the highest temperature. It was then that the uranium cartridges were seen to be at red heat. Attempts were made to discharge the glowing channels, but these were wedged because of distortion of the cartridges. A fire break was then created by discharging adjacent channels. During the night carbon dioxide was brought over from Calder Hall but proved ineffective because the affected part was too hot. A decision to use water was taken at midnight but put into effect at about 9 o'clock the following morning. The fire was controlled in about three hours using water and shutting down the fans, but as a precaution water continued to be poured on for a further 24 hours until the pile was cold.

In annex II of the White Paper, measures taken to protect the workers are recorded. Total body radiation records of all workers concerned in the accident have been examined. Over the 13-week period up to 24 October, only 14 of the workers involved in the accident exhibited radiation levels exceeding 3.0 r per 13-week period. The highest figure recorded was 4.66 r. According to quartz fibre electrometers, recording approximate reading only, two workers received 4.5 r during the accident, one 3.3 r and four others showed levels in excess of 2 r. All the workers who received doses in excess of the maximum permissible level have been taken out of contact with work involving radiation.

A thyroid iodine survey has been made and is continuing. Safe continuous and constant iodine activity in the adult gland is 0.1 μc. The highest thyroid iodine activity so far measured among the staff is 0.5 μc. Strontium activity is being surveyed also. The first 25 results of radio-chemical analysis show levels which at most are one-tenth of the maximum permissible body burden. Evidence on radioactive caesium, caesium-137, is also satisfactory.

On 10 October between 11 a.m. and 2 p.m., a three-hour air sample was taken outside. This gave a count of 3,000 β d.p.m/m^3, compared with a normal level of 200 to 300 βd.p.m/m^3. This was one of the pieces of evidence indicating the probability of a burst cartridge. From 4.15 p.m. onwards half-hourly air sampling was carried out over the factory. 'Worrying' levels of contamination were noted on 11 October at 1.33 a.m., but by noon the air activity was dropping fast. Outside the factory gamma measurements were taken as these are quicker to make than measurements of air activity. The highest gamma reading recorded was 4 milli -R per hour.

With three kinds of hazard in mind,—gamma radiation to the whole body, inhalation and ingestion—the health physics manager considered that the main concern should be ingestion.

By Saturday noon the first analysis of milk samples and the first results on air activity had been obtained. The activity showed a far greater proportion of iodine activity than would normal fission products. It was then known that iodine vapour had come through the filter, although the major part of the particulate material had been caught by the filter. As iodine-131 is quickly carried to cows' milk, milk analysis for iodine was carried out.

No established tolerances level existed for radioactive iodine in milk but a paper by Dr. Scott Russell (ARC/RBC5) was borne in mind which suggested 0.39 μc. per litre as the level beyond which iodine in milk would be a hazard to infants.

First analyses of milk showed iodine-131 contents raging from traces to 0.48 μc. per litre but Seascale morning milk on Saturday showed 0.8 μc. per litre. Distribution of milk in the immediate vicinity of the works was stopped.

In annex III of the White Paper, the report by the Committee on the Health and Safety Aspects of the accident under the chairmanship of Sir Harold Himsworth, secretary of the Medical Research Council, is published. It is stated that the committee are satisfied from measurements obtained that no worker could have inhaled a harmful amount of iodine-131 or that harmful amounts of plutonium or any other element were released.

From measurements of radio strontium in the urine from 30 workers judged to be the most exposed the total amount of radio strontium taken into the body has been calculated. From this it is concluded that for strontium 89, this cannot be more than one-hundredth of that which could be accepted as a sustained level and for strontium 90 it is an even lower proportion of what could be accepted. The evidence now available for radioactive caesium shows that contamination amounted to only a very small fraction of the maximum acceptable level.

The committee conclude their report by stating that they are satisfied 'That it is in the highest degree unlikely that any harm has been done to the health of anybody, whether a worker in the Windscale plant or a member of the general public.'

Composition of the Committee of Enquiry was Sir William Penney, member for weapons research and development and director, Atomic Weapons Research Establishment, UKAEA, Dr. B. F. J. Schonland, director, Atomic Energy Research Establishment, UKAEA, Professor J. M. Kay, Professor of Engineering (Nuclear), Imperial College of Science and Technology, and Professor Jack Diamond, Professor of Mechanical Engineering, Manchester University.

In Parliament

Controlled Thermonuclear Fusion

THE experimental thermonuclear apparatus at Harwell known as Zeta is now operating. This was stated in the House on Monday by Mr. Reginald Maudling, Paymaster-General. Discharges through heavy hydrogen gas have yielded very high temperatures.

He added: 'Experiments are going on to identify the source of the accompanying neutron emission which probably arises from thermonuclear reactions but may possibly be due to other complex nuclear processes. Although the successful operation of Zeta is an important step forward, many major problems remain to be solved before the practical application of thermonuclear reactions can be considered, and the work must be expected to remain in the research stage for some years.

'Research and development in this field are being given the highest priority'.

No Hazards from Caponising with Diethylstilboestrol

Questioned about possible hazards from the caponising of chickens by hormone injections, Mr. Derek Walker-Smith, Minister of Health, said the advice of the Medical Research Council was that experiments had shown that traces of oestrogen remaining in the flesh of the chickens were extremely small. It was also stated that neither carcinogenic nor other undesirable effects were to be expected from the use of diethylstilboestrol.

Mr. Walker-Smith did not think that further investigations were called for.

BIRMINGHAM ANALYST'S REPORT FOR 1956

IN his annual report covering the year 1956, Mr. H. H. Bagnall, the Birmingham City Analyst, deals in a comprehensive manner with many aspects of the rôle of the public analyst in the administration of the Public Health Acts as related to the chemical control of food standards, drugs, and many other commodities. During the year, 37 articles of food were sold, in the words of the Food and Drugs Act 'to the prejudice of the purchaser', nine of these were inaccurately labelled, and 17 were not of the quality expected. Three offences were committed against regulations made under Sections 4 and 123 of the Food and Drugs Act 1955. Twenty-nine drugs were reported as unsatisfactory.

In June this year regulations regarding colouring matter in food were made and the recommended list of allowable colours was adopted, but not the suggestions about the labelling of artificially coloured foods. This is an unfortunate omission, and it is noteworthy that in both the United States and in Canada the words 'colour added' must appear conspicuously on the labels of food to which such an addition has been made.

A report prepared by the Preservatives Sub-Committee of the Food Standards Committee, published by the Ministry in July 1956, makes reference to the use of emulsifying and stabilising agents in foods. A wide range of such substances has been studied, with respect to their value in food processing and it was decided that a number of these, which are natural constituents of foods or are for other reasons common ingredients of food, need not be included in any list of articles, the use of which ought to be regulated. The report further recommended that emulsifying or stabilising agents should not be allowed in milk, and that thickening agents should be prohibited in reconstituted cream as they already are in cream.

Chewing gum is now included in the definition of food in the Food and Drugs Act 1955, and the Ministry has agreed that from 1956 the limitation of the amount of mineral oil, which included paraffin wax, allowed in food to 0.2 per cent, enacted by the Mineral Oil in Food Order 1949, shall not apply in the case of chewing compounds if they do not contain more than 12.5 per cent micro-crystalline wax.

Efficient sampling of drugs has been much discussed for some years past, and the Pharmacopoeias of 1948 and 1953 strongly support the need for more imaginative sampling of drugs. The synthesis and development of the sulphonamide series, of hypnotics, sex hormones, antihistaminics and antibiotics have completely changed the character of these volumes. The new class of synthetic drugs, of which the groups mentioned above form a part, almost monopolises their pages. It is obviously more important to ensure that a solution of penicillin is of the correct potency than to correct a 10 per cent deficiency in the amount of ammonia contained in sal volatile. Practically all the drug sampling in this country is directed towards the cure of minor faults of composition in 'household' articles such as ammoniated tincture of quinine, and cough mixtures, while suppliers of phenobarbitone, sulphaguanidine or promethazine tablets enjoy an almost complete immunity from inspection. This was not the intention of those who drew up the Food and Drugs Act, but it is evident that some defect exists in the application of legislation in the practical problems of sampling.

The constant triumph of hope over experience was once again exemplified by the report of a lady who had paid £2 7s for two preparations to be used for weight reduction. The treatment failed to show the expected results, and this failure was not surprising in view of the compositions of the article. The powder in one bottle contained a mixture of sulphate and carbonate of soda and a synthetic detergent. The emulsion in the other bottle was 90 per cent water and the remainder a saponifiable fat containing extracts of horse chestnut and a trace of potassium iodide. It would require either a state of complete ignorance of such matters or else unbounded faith in order to believe that by rubbing in the powder with a well-soaked friction glove and massaging with the emulsion, any effect whatever would be produced.

The report suggests the setting up of two standards for cheese, one for Cheshire or Cheddar cheese, and a somewhat less stringent one for other varieties. For the former a minimum butter-fat content of 48 per cent in the dry matter of the cheese and a maximum moisture content of 42 per cent is recommended, and for the latter a minimum butter-fat content of 45 per cent in the dry matter and a maximum of 45 per cent moisture.

A report of the Food Standards Committee of rather different type was issued in January 1956 that made certain recommendations regarding the permissible amounts of copper in foods and drinks. As copper is in a different category from arsenic and lead, in that it is a necessary requirement of the human system, the committee considered that consumers would be adequately protected if limits consistent with good commercial practice were observed. General limits were recommended, and special limits for a number of articles peculiarly liable to contain copper compounds varying from 7 to 150 p.p.m. As from the public health point of view, the presence of traces of copper in foods is a less serious problem than that of other metals, it was considered to be unnecessary to give statutory effect to the limits recommended.

ICI Chairman Heads Three Committees to Study Windscale Problems

IN a memorandum to the Prime Minister, Sir Edwin Plowden, chairman of the UK Atomic Energy Authority (annex IV of the White Paper) states that the Authority accept full responsibility for the Windscale accident. All steps to ensure there can be no similar occurrence in any part of the Authority's establishments will be taken.

The Authority, after considering the findings of the committee of enquiry, conclude that the cause lay partly in inadequacies of instrumentation provided at Windscale for the maintenance operation that was being carried out at the time of the accident and partly in faults of judgment by the operating staff. These faults of judgment 'were themselves attributable to weaknesses of organisation'.

Immediate measures have been taken by the Authority to deal with the organisational weaknesses pending a more comprehensive evaluation of the remedies that are required. The Authority suggested, however, that the Prime Minister should appoint some independent person of standing, who had experience of large-scale organisations operating processes involving hazardous materials, to undertake this evaluation and to recommend what technical and organisational improvements were required. Until this work is complete, Windscale Pile No. 2 will not be put back into operation.

As a result of this recommendation the Prime Minister has appointed three committees with Sir Alexander Fleck, chairman of Imperial Chemical Industries Ltd., as chairman of all three. The *Technical Evaluation Committee* will: Study the technical information relating to the design and operation of the Windscale piles, which is to be derived from the accident; make a review of the factors involved in the controlled release of Wigner energy and to make recommendations to the Atomic Energy Authority on procedures for carrying out this operation to be adopted in future; and to make a recommendation to the Authority regarding the restarting of the Windscale Pile No. 2.

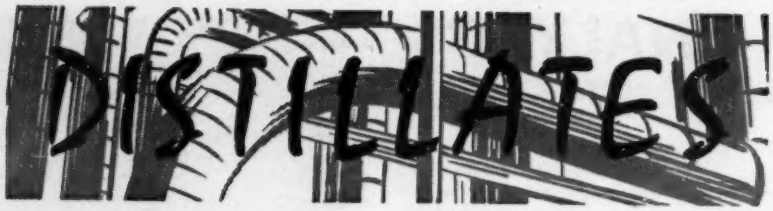
Members: Sir Alexander Fleck (in the chair); Sir John Cockcroft; Sir William Penney; Dr. R. Spence (chief chemist AERE, UK AEA); Professor Jack Diamond; Professor J. M. Kay and Professor H. W. B. Skinner (Nuclear Physics Laboratory, University of Liverpool).

The *Organisation Committee* will: Review the organisation and staffing of the operations branch of the Industrial Group of UKAEA and make recommendations; and will review similarly the staff engaged on the operation of reactors in the Authority's Research Group and make recommendations.

Members: Sir Alexander Fleck (in the chair); Mr. C. F. Kearton (director of Courtaulds and member UK AEA); Sir William Penney.

The *Health and Safety Committee* will: Review the organisation within the Authority as a whole for control of health and safety and to make recommendations.

Members: Sir Alexander Fleck (in the chair); Mr. C. F. Kearton; Sir William Penney; Sir George Barnett (Chief Inspector of Factories) and Dr. J. S. Carter (Chief Alkali Inspector).



ONE of the most interesting papers to be presented at the British Institute of Management conference on research last week came from Mr. A. Wormald, commercial director of Fisons Ltd. His paper, in fact, was an object lesson on how the results of research could most profitably be developed (see p. 805).

He called for a bolder view about commercial exploitation in this country and a greater willingness to risk large sums of money in promotion. The commendable aim that he put forward was not one of gradual expansion, in most cases proceeding from the home market to export markets, but a simultaneous advance on a broad front. An important point in this connection was one of price. For instance, it would often be justified to intensify the effort on promotion and customer acceptance in order to tap that part of the demand that could yield the largest profits.

This is not the way ahead for the chicken-hearted, but it should never be forgotten that the success stories of the chemical industry have been made possible by the taking of calculated risks. It is a waste of valuable time, effort and money not to exploit to the full a new product or process; in any event, surely investment to exploit the results is as justified as investment in research itself.

THE DSIR Building Research Station will doubtless be interested in the prediction that homes will one day be constructed of plastics materials funnelled from helicopters hovering over a building site. Mr. Henry H. Reichhold, president of Reichhold Chemicals Inc., believes the plastics house will be 'just one more development that will triple the volume of plastics and chemical industries in the next five years'.

He forsees walls and foundations of plastics that will be poured through hoses from helicopters fitted with the type of equipment ordinarily used for cement mixing. Driveways as well as houses would be plastics.

'This may seem fantastic now', says Mr. Reichhold, 'but so did spraying crops from the air when first suggested'.

HOW the Government's new restrictive policy on capital expenditure is likely to affect the plans of ICI was outlined recently by Mr. C. M. Wright, the company's development director, when he presented long service awards to 80 members of the Billingham division staff. He said that a company as large as ICI was bound to take notice of Government policy not only in the interests of the company, but in the interests of the country as a whole.

The company will be looking very carefully at all requests for capital expenditure which come forward for sanction, and it is likely that in the next few months requests for 'desirable amenities like office buildings will have a pretty thin time'. This does not mean that new plants will not be built or existing plants improved. Rather does it mean that some plants will be made to last longer before being replaced.

Mr. Wright added that the company had no wish to restrict expansion, but the best interests of the country had to be considered. He felt that the current financial restrictions would last for a comparatively short time and as major capital projects could take two or three years to complete and bring into operation the company did not wish to restrict capital investment any more than was necessary, but wished to provide for the future.

IN OUR recent report of the open days at the DSIR Chemical Research Laboratory, Teddington (CHEMICAL AGE, 12 October, p. 593) we referred to a high-voltage paper electrophoresis apparatus 'developed by the organic group'. The technique of high-voltage paper electrophoresis was developed in this country by Dr. D. Gross, of the Tate and Lyle research laboratories at Keston, Kent (see *Nature*, 1953, **172**, 908; 1954, **173**, 487; 1955, **176**, 72, 362; 1956, **178**, 29; 1957, **180**, 596).

The apparatus was constructed by CRL, who are indebted to Dr. Gross for supplying full details for this purpose.

THERE are many supporters for the belief that non-scientific subjects should be included as compulsory in the three-year first degree course. There are many arguments in favour of this but they are outweighed by the disadvantages. My interest was aroused by what Dr. R. P. Linstead, Rector of the Imperial College had to say in the ninth Hinchley Memorial Lecture of the Institution of Chemical Engineers, which he presented last week under the title 'An education for our times?'

Dr. Linstead stated his belief that the humanities should not run concurrently with studies of science, but that the college or university should make continuous and organised effort to provide facilities whereby a student can broaden his outlook, interests and experiences. What he had in mind was by student clubs and societies and perhaps an optional general studies programme.

There are also certain types of non-scientific studies which arise 'out of a man's vocational interests and should very properly be studied in an organised way as part of them, or side by side with them'. Here Dr. Linstead instanced such subjects as foreign languages, particularly Russian, and the English language, aspects of economics for engineers and the history of science and technology.

In the last analysis it is more important for a technological university to provide the facilities for a full life in humane surroundings than to organise classes for this, that or the other non-scientific subject.

A 'DO-IT-YOURSELF' film unit has been set up by a volunteer group of employees to prove to their company, Baker Platinum Division of Engelhard Industries Ltd., that films are indispensible to training, sales promotion and general publicity. The group is a cross-section of personnel from the works director downwards and in its own time and with its own money it is making its first film which covers many of the company's manufacturing processes.

The idea for an organisation capable of filming precious metal processes came when employees saw industrial films produced by other companies. The film unit meets weekly in the firm's conference room and after an initial orientation, views the shots taken the previous week and analyses the quality of the work. Members then film the particular operation in the works that has been assigned by the script writers.

The finished film will be shown to all employees and to other interested organisations. It is hoped to produce a version in colour to enter for any suitable competition.

THE new mace presented to the Manchester College of Science and Technology to mark the granting of university status, stemmed from a 1956 reunion of ex-scholarship holders. Their suggestion for the presentation was warmly supported by the governors of the engineering scholarship fund who, at their own request, have participated on an equal basis.

The mace incorporates the arms of the college, the university and the city, with motifs indicating the origin of the fund. The mace-bearer is to be Mr. J. Sweet, a chemical engineering student, who is assistant secretary of the students' union.

The fund was set up in 1922 by a voluntary association of engineering firms established during the war to organise and control the munitions industry. When the fund was exhausted in 1936, the Manchester and District Employers' Association stepped into the breach. A total of 72 awards have been made and at present the college has five scholarship holders.

Alembic

EXPLOITING RESEARCH RESULTS

Too Much Energy Wasted on Exploiting US Inventions, says Fisons Director

CRITICISM that too much energy was wasted on the exploitation in this country of US inventions was made at Bournemouth last week by Mr. A. Wormald, commercial director of Fisons Ltd. Mr. Wormald was speaking on 'Exploiting the results of research' during the annual conference of the British Institute of Management at Bournemouth. Attended by 620 managers from all parts of the UK, the subject of the conference was 'Research—a signpost to better management.'

Mr. Wormald declared 'Important firms in many industries do now little more than build plants to use American processes and provide technical service. This absorbs much scientific ability which might otherwise be devoted to creative work. In all these licence agreements, large portions of the world are reserved to the American originators of the invention and so automatically, as it were, the situation of unbalance is perpetuated. The excessive protection afforded to home British industries indeed encourages this rather sterile process of imitation and removes much of the impetus to invention.'

Introducing his paper, Mr. Wormald said he would largely confine his remarks to the stressing of some general principles of importance. He pointed out that his company operated in the pharmaceutical and pest control industries, where research absorbed up to 10 per cent of sales revenue and where the exploitation of the results was of prime importance.

Lack of Understanding

Mr. Wormald declared that in England, but not in America nor Germany nor even France, the management of industry was largely without scientific training and often without an understanding of the nature of the scientific work or the processes of thought which it involved. As a result the research worker lost much by the inability of those he worked with to enter into communion with him.

Conversely, unlike America, the UK scientist had little understanding of, or respect for, those highly pragmatic processes of thought involved in the translation of his work into material objects. This was a serious defect of scientifically based industries in this country.

The decision on the amount of effort to be apportioned to the particular item in the research programme must in itself reflect the image, however hazy and imperfect, of the future product. Mr. Wormald declared that a clear and definite understanding should exist in every business of the relative importance for that business of research, development and marketing; that understanding should be subjected to constant reappraisal and should be the subject of written reports by the development, production, marketing and any other departments closely associated with research; every company should have a research or new projects committee to scrutinise such reports in the light of all factors.

Turning to the exploitation of a new invention, whether process or product, Mr. Wormald stated that there was much in common between laboratories competing

A. Wormald, commercial director of Fisons

in a given field. There were certain ideas in the air; certain advances in related fields had made possible new developments and there was intelligence of what others were working on. So that in many cases, a discovery of real importance was likely to be threatened by similar discoveries made in competing laboratories.

From that source came the first trial of the co-ordinating body of a business into whose purview the invention had come. The whole or a part of the value of the invention could be lost at that stage either by launching the product prematurely at the earliest possible moment, or by delay to achieve a better product or process, allowing others to press ahead.

There were no rules or given procedure to help at this stage. It was a test of judgement and character and of power to restrain fear and check impatience. The patent situation would have a considerable bearing on the decision to be made. If the primary invention could be made the subject of a patent of wide ambit and if the research had covered much of the adjacent territory, then the decision was simplified. There would be time to develop the invention almost at leisure and to build up an imposing structure of ancillary patents. But those were rare cases; in the chemical field nylon and polythene were among the few examples. In most cases perhaps, patents were regarded, at the best as a second line of defence, speed and secrecy in attack being the first.

At this stage the research head must give a sober estimate of the dangers in proceeding, either from failure of the product or progress by other laboratories; the sales people must say whether the product is needed with greater or less urgency; the finance director whether funds would be there for the project or whether it must wait.

If the project went ahead, forward estimates must be made of the development cost, i.e., the cost of producing a prototype or a process which would produce a saleable product. If the resources were not equal to the task, time would be lost and time might be the most vital element. There were no statistics, but there was a strong impression in industry that many projects failed at the development stage, because the balance between research and development resources had been miscalculated.

At some point in the development phase must come the decision to build a pilot plant, and in the chemical industry a pilot plant was coming to be recognised as more of a commercial requirement than technical. The technical problems of scale were often such that they could only be solved with confidence for units of a given size and experience at one level was not necessarily applicable to practice at another. For commercial purposes, however, the pilot plant was nearly always a necessity unless the material was so small in bulk that laboratory quantities would suffice for extensive trials. In most cases only from pilot plant experience could cost data be computed to enable the potential off-take and hence the scale of actual production to be calculated.

At the pilot plant stage, major decisions must now be faced. The process must be 'frozen' and development work separated from design and construction. Failure to decide in time and to make such a separation might result in a better process being built into the full-scale plant, but it would cause disproportionate increases in design and construction expense and delays in completion.

Largest Economic Unit

The size of the full-scale plant must also be fixed. The plant must be the largest economic unit possible, for the larger the plant, within limits, the lower would be operating costs. Also, during construction it would be possible to develop the market further, a factor which must be allowed for in estimating potential off-take.

In the process industries, the decision on plant size was generally a compromise between:

i. The optimum size to give lowest cost of production.
ii. Doubts about the finality of the process and prospects of improvement.
iii. Available finance.
iv. Necessity or otherwise of working the plant at a profitable level in the early stages.
v. Confidence in market forecasts.
vi. An estimate at the earliest time at which it would be possible to consider building another plant.

The larger the plant, the greater the protection against competition since latecomers would obviously be deterred from putting up new capacity when they knew that there was a margin of spare capacity already in existence.

In this connection market research estimates needed careful scrutiny. If the material was new there might be a tendency to underestimate potential demand; in addition to those uses where the material would be likely to supplant direct competitors.

allowance would have to be made for new uses. Nor must the first cost of the material only be considered; it would often be the cost in use, or value to the consumer which would decide the price he would pay.

On the other hand it was easy to underestimate the time necessary to secure adoption of a new material and the theoretical potential off-take must be corrected by an estimate of the speed at which the potential could be tapped to handle the new material.

The next stage was to make the marketing plan. In this country it was much easier to secure approval for a large investment in plant than for investment in marketing.

'Herein', declared Mr. Wormald, 'lies one of the more fundamental differences between American and British industry, in that largely because of the greater development of marketing science American business men are more ambitious in planning than British. There is a need for a bolder view about commerical exploitation in this country and for a greater willingness to risk large sums of money in promotion'.

The aim should be not gradual expansion in most cases proceeding from the home market to export markets, but a simultaneous advance on a broad front.

In the cause of boldness, another point might be made; for many products, for most indeed in the chemical industry, there were some uses which would stand very high prices and many which would not; in the economists' language the elasticity of demand was high. In those cases it would often be justified to intensify the effort on promotion and customer acceptance in order to tap that part of the demand that could yield the largest profits. Thus if 1,000 tons of the product were available it might be justified to create a demand for 10,000 tons in order to take the highest priced demand first. Production facilities could then be enlarged to cater for the rest of the demand at lower costs and prices.

The final stage was the creation of use research and service facilities. This called for a careful appraisal of the facilities available from customers. It was the custom to rely largely on the user to develop the product, but in practice that was more often unsatisfactory than not. The user had his own vested interests and a disinclination to put himself too much in the hands of a supplier of a heavily protected material.

Industry's Uncertain Approach to Research as an Investment

THE attitude of many firms to research had been uncertain in the past, said Dr. Alexander King, deputy director of the European Productivity Agency, in his paper, 'Research as an investment', presented at the Bournemouth conference last week. He referred to 'Lack of comprehension of the time required, no understanding that much research, even when successful, does not lead to a brilliant new product, and a complete lack of healthy relationship between research and general investment programme of the company. In other instances, research has been a type of prestige publicity, a matter of keeping up with the Joneses.'

'Equally Wrong'

Both those approaches were equally wrong. Those firms who were most successful with research programmes had a clearly-defined managerial policy. The level of the research programmes based on the turnover of the firm would, of course, vary from industry to industry and in accordance with the general rates of technical progress. It was also connected with general capital investment programme of the company. Development of a successful research discovery to production cost 10 to 20 times the amount of the research itself. Consequently, too much research with insufficient means to exploit it was managerially senseless.

Many attempts had been made to assess the yield from research, but such assessments seldom meant much. Only a small proportion of research undertaken for industry yielded a definable result in terms of new products or processes. The few which had led to such success no doubt paid for the programme—and much more.

Dr. King stressed the high proportion of new products in British industry, saying: 'Already a large part of our exports consist of manufactured goods unknown before the war and a high proportion of our progressive industry is based on scientific discoveries made in the last few decades. In the US it has been calculated that since the end of the war 50 per cent of industrial growth has been in the form of products not manufactured at all at the outset. It is further anticipated that in the next six years 80 per cent of industrial growth in US will be in the form of products not yet sold.'

Value of RAs Grows with Use by Industry

'The research association—an aid to firms great and small' was the title given to the paper read by Dr. J. G. Pearce, a director of the British Cast Iron Research Association. 'The potential value of a research association increases the more it is used and consulted by industry,' Dr. Pearce declared, 'for only in this way can reconciliation be effected between empirical and scientifically established knowledge, and surmise replaced by certainty.

'Management should appreciate that in many cases an unqualified answer cannot be given to many problems and this is the point where an experimental programme may provide the answer. It is for this reason that industrial contacts are as important to a research association as to the manufacturing firm. Awareness of the current industrial situation is of the highest value to a research organisation, without which the experimental projects likely to be most promising cannot be formulated.'

Of his own association, Dr. Pearce said that enquiries reached the two establishments at the rate of 13 each working day, of which two-thirds required the attention of the development or research staff, and the remainder could be dealt with by the intelligence department from recorded material.

'Go Home and Sack Someone, If . . .'

In his paper 'Research—a management technique', Professor C. F. Carter, department of economics, Queen's University, Belfast, advised managers to 'go home and give someone the sack' if their research department was wholly given over to science and technology; if it chose its jobs because they were scientifically exciting and regarded sordid matters of finance as a problem for some other department; if it regarded itself as a cut above chaps who produced things and several classes away from chaps who sold them.

Professor Carter said that money spent on research and development was an investment in the possibilities of future progress; it must be conceived as part of the broad strategy of the firm, just like any other investment.

In the 18th and 19th centuries, technical progress came by accident, by the curiosity of inspired individuals. Now it was much more a matter of planning, of the investment of resources in creating the possibilities of advance.

British research and development expenditure doubled between 1930 and 1938 and doubled again between 1938 and 1950 and was still rising fast. There was no sign that the economic limit had been reached.

First Polymer from ICI's New Nylon Works

PRODUCTION of the first polymer from nylon salt imported from the Continent has been accomplished at the new nylon works of ICI dyestuffs division at Wilton. The polymer has been delivered to British Nylon Spinners Ltd., Pontypool, for manufacture into nylon fibre. Despatch of the first batch of polymer means that the construction programme which began in July 1955 is now nearing completion.

By the end of 1957 it is anticipated that the four main areas of the works, solvents, acids, refinery and polymer, will be completed. All should be operating at some level by that time, building up to polymer production from the plant's own resources early next year.

The imported salt has been used to establish and prove equipment ready for when the other intermediate plants can complete the production cycle.

KID Exemption Extended for Phthalic Anhydride

The Treasury have exempted the following articles from Key Industry duty for the period 19 November 1957 to 18 February 1958: Ethyl lactate (an ethyl ester); maleic acid; maleic anhydride; methyl reserpate *O*-ethoxycarbonylsyringoyl ester (a methyl ester); phthalic anhydride.

The order is the Safeguarding of Industries (Exemption) (No. 11) Order, 1957 and copies may be obtained (price 2d., by post 4d) from HM Stationery Office, London.

Oslo Conference on Antibiotics in Animal Feedstuffs

THREE PAPERS were read at the Scandinavian conference on antibiotics in animal feeds, which was held at the Norwegian Veterinary College, Oslo, Norway, on 8 November. Discussion groups took place after each of the papers, involving leading scientists in this field from various countries.

Dr. Johan Baelum, Danish State Experimental Laboratories, spoke on mass experiments on Danish poultry. Dr. Harold Hvidsten, Agricultural High School, Norway, discussed the value of aureomycin for calves, and Dr. Ralph F. Elliott, director of pig development, American Cyanamid Co., US, dealt with the results of giving aureomycin in sows' feeds.

Antibiotics Improve Growth of Poultry

Ten experiments at the Danish State Experimental Laboratories, involving over 5,200 chicks, had shown that in every case antibiotic feeding improved growth rates by four to 12 per cent and improved feed conversion by four per cent, Dr. Johan Baelum said. The tests were carried out in different places with ungraded chicks or with pullets or cockerels only. An even more significant finding of Dr. Baelum's was that pullets fed antibiotics from hatching right through to maturity weighed eight per cent more when they began laying than unsupplemented controls.

Aureomycin for Calves

According to Dr. Harold Hvidsten, as calves given aureomycin in their rations ate more concentrates and grew faster, it might be possible to reduce the allowance of whole milk and thus cut feeding costs. Increased feed intake resulting from antibiotic supplementation was undoubtedly the major cause of the calves' quicker growth. Another reason was the improved health of the antibiotic-fed calves, particularly the lower incidence of digestive disturbances, notably scours.

Comparing the effects of various antibiotics, Dr. Hvidsten said he had found greater responses with aureomycin than with penicillin or terramycin. Extra weight gains varied from eight to 21 per cent over controls for aureomycin and nil to 29 per cent for penicillin in comparative trials. Carcase quality of veal calves was improved, particularly by aureomycin and calves receiving the supplement had sold for as much as 35 per cent more than controls, leaving an extra profit of nearly 65 per cent after feed costs were deducted.

Larger Litters When Antibiotics Added to Sows' Feeds

Latest experiments on adding aureomycin to sows' rations before farrowing and during suckling resulted in heavier and bigger litters of pigs at weaning, said Dr. Ralph F. Elliott. This effect was additional to the extra weight gains which could be expected from adding aureomycin to creep and starter feeds.

Controlled feeding trials on 50 sows showed that antibiotic supplementation was of considerable benefit to breeding stock. Litters from the antibiotic-fed sows had lower mortality, higher daily weight gains and graded better than controls, said Dr. Elliott.

'For practical application the seven per cent lower mortality due to the sow treatment might be equivalent to a litter of pigs saved in a 35-40 head operation. The return over feed cost for two pigs would cover the cost of the antibiotic consumed by the 35-40 sows. The other five pigs saved would add further to the producer's economic returns.'

Adding antibiotics to the starter rations was even more important in obtaining higher weaning weights. The general procedure was to add 200 grammes of aureomycin to the sow rations for approximately 10 days before farrowing and for seven days after farrowing. The level of aureomycin was then decreased to 50 grammes per ton during lactation. Minute quantities of aureomycin could be detected in the milk of the sows receiving the antibiotic, Dr. Elliott added.

In another experiment sows were given the antibiotic for 30-60 days before parturition and the litters in each generation received aureomycin throughout the study. Average litterweights in the control groups (no aureomycin) were 191.2 lb. at weaning, against 229.6 lb. for those receiving the antibiotic—an improvement of 20 per cent. The numbers weaned were increased from 5.7 to an average of 6.9 for the aureomycin-fed groups over five generations.

Fundamental Approach to Theory of Dyeing with Disperse Dyes

MANY of the investigations of cellulose acetate had been concerned with the mechanism of dye uptake. Comparatively little had been reported about the affinity operating between dye and substrate, said Dr. T. G. Majury (Research Laboratories, British Celanese Ltd.), when speaking to the Manchester Section of the Society of Dyers and Colourists, recently, on the subject of 'A fundamental approach to the theory of dyeing with disperse dyes'.

The range of disperse dyes for cellulose acetate consisted generally of azo-benzene and anthraquinone derivatives. A common feature was the high degree of polarisability and, very often, a polar character which was permanent.

There appeared to be three modes of interaction (1) dipole-induced dipole (2) dipole-dipole and (3) the special form of dipole interaction known as hydrogen-bonding.

Work was started with a series of five model dyes. The heats of dyeing for these dyes on cellulose acetate had been measured and by combining these with the heats of solution and sublimation of the dyes, the absolute heats of association between dyes and substrate might be evaluated. Later, the question of dyeing from the vapour phase was considered, and absorption measurements were carried out over a range of temperatures with each model dye.

The vapour pressure of the dyes had also been measured over a range of temperatures, those of azo-benzene by manometry and the remainder by Knudsen's effusion method combining the two sets of vapour experiments; absorption isotherms were obtained and used to evaluate the heats of absorption of the vaporised dyes.

Comparing the results with the absolute heats of association derived from conventional aqueous dyeing experiments, it could be seen that the two methods of measurement of bond strength which had been adopted gave results which were very close for at least three of the five model dyes under investigation.

It would appear that for the two amino-azo-benzene derivatives the aqueous dyeing method led to slightly higher values than did the vapour absorption method. As a measure of bond strength, there was little doubt but that the vapour method was to be preferred.

Consideration of the heat of absorption in relation to dye structure gave results which confirmed earlier conclusions, viz: that heats were of the same order as those of condensation to the solid dye, and this in turn suggested a similarity in the forces between dye and substrate and those between neighbouring molecules in the dye crystal.

Hydrogen bonds could contribute at most only a small fraction of the total forces, the greater part of which seemed likely to be due to dipole and dispersion interactions.

Complexometric Titrations Discussed by Dr. Pribil

SEVERAL solutions to the problem of making complexometric titrations more selective were discussed by Dr. Rudolf Pribil of the Czechoslovak Academy of Sciences on 5 November. Dr. Pribil was presenting a paper on 'Recent developments in chelatometry' at a meeting of the Society for Analytical Chemistry.

Dr. Pribil discussed the influence of pH on the test solution. The main problem was the choice of suitable indicators. The theory of the metallochromic indicators was outlined and the colour transitions of the new indicators, xylenol orange, methyl thymol blue, Thymolftalexon, Fluorexon, etc., were demonstrated.

New screening agents, especially those used for the lower range of pH, consisted of a further range of compounds which enhanced the selectivity of complexometric titrations.

Zero Energy Reactor Goes Critical at Harwell

NEPTUNE, a zero energy reactor built at the Atomic Energy Research Establishment, Harwell, is now in operation. It went critical for the first time on 7 November. Neptune will be used to study the detailed behaviour of neutrons in water-moderated core designs, with specific reference to a pressurised water reactor for submarine propulsion. The reactor will be used to check the design calculations for the land-based prototype submarine reactor, for which civil engineering work has begun at the establishment at Dounreay.

The reactor uses enriched uranium as the fuel and ordinary water as the moderator; no special cooling is required since only a few watts of heat will be generated. The reactor has been designed to allow the rapid assembly of many different kinds of cores. The core of the reactor is formed by assembling boxes of fuel element plates inside a large heavily shielded aluminium tank which contains the water moderator.

The level of the water in the tank can be adjusted precisely to any required level and is used as one means of regulating the reactor. An additional method of control is by a neutron-absorbing cadmium rod, moving vertically in or out of the reactor core. The reactor is shut off by allowing two groups of neutron-absorbing plates to fall by gravity into the core, and by dumping the water at the same time into storage tanks situated beneath the reactor. The reactor is not pressurised, but the water can be heated to about 90°C to study the variations in neutron behaviour caused by increased moderator and fuel temperatures.

The principal sub-contractors in the design and construction of the reactor itself were Elliott Bros. (London) Ltd. and Head Wrightson (Teesdale) Ltd. Among sub-contractors were:

Rolls-Royce Ltd., responsible for project as a whole and for the design, manufacture and installation of all items with the exception of instrumentation and electrical power supplies: Elliott Bros. (London) Ltd., responsible for the design, manufacturing and installation of all instrumentation and electrical power supplies; Head Wrightson (Teesdale) Ltd., complete erection of reactor on site.

G. Hopkins and Sons Ltd. Manufacture of: control mechanisms, reactor pumps, water level probe, main dump valves, various items of prefabricated pipework, reactor tank internal top structure.

The APV Co. Ltd., reactor tank, dump tank, transfer tank, auxiliary pumps; J. Thorp and Sons Ltd., structural steelwork and crane gantry; F. E. Robinson (Horton) Ltd., steelwork and driving mechanism for shutters, source winding gear; Marston Excelsior Ltd., light alloy water cooler; Keith Blackman and Co. Ltd., cooler fan and ducting; Heatrae Ltd., 150-kW. water heater; F. G. Miles Ltd., main shut-off absorbers and coarse water level switch, ion chamber mountings.

Palatine Tool and Engineering Co. (Surbiton) Ltd., fine control valve; Blocktube Controls Ltd., control system for fine control valve; Boremaster Ltd., lattice plate and fuel element locking bars; C. W. Fletcher and Sons Ltd., fuel element boxes and various items for core assembly; The Magnetic Valve Co. Ltd., electrically operated valves; Terraspan Ltd., various items of prefabricated pipework and stainless-steel assemblies; Stemco Ltd., Gilbarco water level indicator.

New BDH Aromatic Intermediates

NEW AROMATIC intermediates added to the British Drug Houses' BDH Catalogue are: 2 chloro-4-nitrobenzoic acid, a pale orange-yellow crystalline powder, melting point 139°-141°C; 5-chloro-o-toluidine (2-amino-4-chloro-toluene), a dark brown liquid (solid in cool weather), freezing point 22°C; 3-chloro-p-toluidine (4-amino-2-chloro-toluene), a dark reddish brown liquid (solid in cool weather), freezing point 23°C; 2:3 dichloro-aniline, a brown crystalline mass or dark brown liquid; freezing point 20°C; 2:4-dichloro-nitrobenzene, a pale yellow crystalline solid, melting point 32°-33°C; 2:4-dichloro-toluene, slightly tinted liquid, boiling point 198°-200°C; 2:6-dichloro-toluene, a colourless liquid, boiling point 197.5° to 198.5°C; 1:2:3-trichloro-benzene; an off-white crystalline powder, melting point 55°-57°C; 3:4-xylidene, pale brown crystals, melting point 51°-53°C.

Also new to the catalogue are 2-dimethylamino ethanol (N:N dimethyl-ethanolamine), 2:9-dimethyl-1:10-phenanthroline (neo-cuproin), 4:7 diphenyl-1:10-phenanthroline (haltro-phenanthroline), 2-ethyl-hexoic acid and pyriolidine 2-dimethylamino-ethanol, a brownish-yellow liquid boiling at about 134°C has been suggested for decreasing the setting time and increasing the ultimate hardness of lime plasters and cements. While a series of US patents (No. 2,580,923, 2,580,924 and 2,582,138) suggest its use for preventing corrosion in steam generation, it is also used in the manufacture of certain anion exchange resins.

Spectrophotometric determination of copper has been accomplished in a number of materials, particularly beverages, using 2:9-dimethyl-1:10-phenanthroline (Sallavo, Suomen Kemistilehti, 1954, **27B**, No. 5/6, 46-48). The method is stated to be applicable to most determinations of copper in food after organic matter has been destroyed. Use of 4:7-diphenyl-1:10 phenanthroline has been described for the colorimetric determination of iron in raw and treated municipal water supplies.

Good flotation of pitch blende over the pH range 2.8-6.0 is claimed with the use of 2-ethyl-hexoic acid, while an Italian patent 470,586 suggests that the cobalt salt has an exceptionally high anti-knock effect in petrol.

Esso at Milford Haven

The terms of the general planning approval given by the Minister of Housing and Local Government to Esso Petroleum Co.'s proposals to build a refinery in the Milford Haven area are now being studied. Discussions are still necessary with various other Government departments. It will therefore be some time before Esso Petroleum Co. can reach a final decision on this project.

Rapid Measuring of Metals in Very Dilute Solutions

So precise is a new electrolytic method of measuring metals in very dilute solutions that it can measure one part of lead in five trillion parts of solution, chemically a 10^{-9} moles per litre concentration. It is so sensitive that lead absorbed into solution from glass walls of a container will upset the readings.

This new analytical procedure, known as anodic stripping voltammetry, was developed by Professor Irving Shain and Richard D. De Mans of the University of Wisconsin. A continuously varying potential using the hanging mercury drop electrode is involved. The mercury drop is about 0.07 cm. in radius which hangs from a platinum wire. With this electrode charged negatively, the metal ions in solution slowly electroplate on the mercury drop.

If a solution were not so dilute, the concentration could be measured by a sharp, characteristic jump in current as the voltage on the electrode became more negative. However, in the range of concentrations of 10^{-6} to 10^{-9} moles per litre, a residual current masks these peaks.

Anodic stripping has therefore been used. After 15 minutes to an hour of electroplating, depending on the concentration, the voltage charge on the drop of mercury is suddenly reversed. This abrupt change forces or 'strips' the accumulated metal from the mercury in just a few seconds. The concentration can then be measured by a positive peak in the current voltage curve.

Judgement Reserved on Evans Medical's Appeal

FURTHER legal argument was heard last week by the House of Lords (before Viscount Simonds, Lord Morton, Lord Tucker, Lord Keith and Lord Denning) in an appeal by Evans Medical Supplies Ltd. regarding the Crown's claim to tax on a sum of £100,000 received by the company from the Burmese Government in 1953.

The Crown is appealing from a direction of the Court of Appeal remitting the case to the Special Commissioners to say whether any part of the £100,000 represented payment for information about secret processes used by the company. The company is cross-appealing against the Court's reversal of Mr. Justice Upjohn's finding that the whole sum was a capital payment and therefore not taxable.

Judgement was reserved.

ICI Bomb Scare

About 50 employees, skeleton Saturday staff, at the Glasgow offices of ICI Ltd., 460 Sauchiehall Street, were evacuated from the seven-storey building after a telephone call had been received stating that it was to be blown up. It is understood that the call was made by a person purporting to be a member of the 'Scottish Republican Army'. The caller stated that there would be an explosion in half an hour. CID officers then carried out a search on all floors but nothing was found.

NEWER PREPARATORY METHODS IN ORGANIC CHEMISTRY

Chemical Society and SCI Symposium

SIX papers were presented at a one-day symposium on 'Newer preparative methods in organic chemistry', held by the Chemical Society and the fine chemicals, group, Society of Chemical Industry on Thursday, 7 November at the Chemistry Department, University College, Gower Street, London WC1.

Papers read in the first session with Dr. B. A. Hems as chairman were 'Amine oxidations' by H. B. Henbest (King's College, London); 'Dehydrogenation with manganese dioxide' by R. M. Evans (Glaxo Laboratories Ltd., Greenford); and, 'Organic oxidations with hexavalent chromium' by R. Slack (May and Baker Ltd., Dagenham).

In the second session with Professor E. R. H. Jones in the chair, the following papers were given: 'Mixed anhydrides as synthetical reagents' by G. W. Kenner (University of Liverpool); 'Some reactions between metal carbonyls and acetylenic compounds' by M. C. Whiting (Dyson Perrins Laboratory, Oxford); and, 'Some applications of metal carbonyls in organic chemistry' by P. O. Lenel (Imperial Chemical Industries Ltd., Billingham).

Mixed Anhydrides

Principles governing the use of mixed anhydrides as intermediates during the condensation of oxy-acids with nucleophilic reagents such as amines and alcohols were discussed by G. W. Kenner in his paper on 'Mixed anhydrides as synthetical reagents.' In particular, attention was directed to mixed anhydrides of two oxy-acids which, in some circumstances, have advantages over the other, more generally useful mixed anhydrides, such as acyl chlorides and acids. Mr. Kenner said that during the two stages of the condensation process the oxygen atom, which is shared in the mixed anhydride, is transferred from the first oxy-acid to the second, and therefore the whole process can be conducted in one series of laboratory operations without wasteful isolation of the mixed anhydride. Furthermore, the second partner in the mixed anhydride can be selected from a wide range of oxy-acids so as to give the correct reactivity to the mixed anhydride.

Two well established procedures were cited—the preparation of alkyl benzyl phosphonates through the mixed anhydride of monobenzyl phosphonic and diphenyl phosphoric acids(1) and the synthesis of peptides through mixed anhydrides of carboxylic acids.(2)(3)(4)

In the latter instance cleavage of the mixed anhydride at two points, which was a general drawback of working with mixed anhydrides of two oxy-acids, had to be considered. In this instance the nucleophile attacked the more electrophilic centre, but with pyrophosphates the situation was reversed and also there were examples of differing behaviour with different nucleophiles or solvents. Mr. Kenner interpreted these differences in general terms of varying importance of bond formation and bond fission. Occasionally he said, steric hindrance could be employed for directing the cleavage.

Particular stress was laid by the author on a fourth factor which often exerted overwhelming control of the cleavage of *heteromeric* mixed anhydrides, i.e. those of two dissimilar oxy-acids. This was a difference in the co-ordination numbers at the two electrophilic centres. The dominance of this factor appeared in the reactions of acyl phosphates, which were generally attacked by nucleophilic reagents at the carbonyl group. The great difference in speed of alcoholysis of alkyl nitrites and nitrates had the same cause, and it was noteworthy that dinitrogen tetroxide was a nitrosating rather than a nitrating agent(5). When this factor could be brought into play, *heteromeric* mixed anhydrides were to be preferred to the *homomeric* as reagents; in addition to the preparation of alkyl benzyl phosphonates, synthesis of peptides through acyl sulphates(6) was mentioned as an example of their use.

Finally Mr. Kenner emphasised that mixed anhydride procedures demanded good experimental technique, particularly with respect to exclusion of moisture, control of temperature, and timing of the operations. Consequently he considered they should be reserved for special cases in which acyl halides were unsatisfactory.

REFERENCES

(1) Corby, Kenner and Todd, *J. Chem. Soc.*, 1952, 3669.
(2) Wieland and Schring, *Annalen*, 1950, **569**, 122.
(3) Boissonnas, *Helv. Chim. Acta*, 1951, **34**, 874.
(4) Vaughan, *J. Amer. Chem. Soc.*, 1951, **73**, 35471.
(5) Gray and Goffe, *Quart. Revs.*, 1955, **9**, 381.
(6) Kenner and Stedman, *J. Chem. Soc.*, 1952, 2089.

Oxidation of Tertiary Amines

IN HIS paper on 'Amine oxidations', H. B. Henbest said that tertiary amines are readily oxidised by a variety of reagents, the initial products usually being N-oxides, enamines or carbinolamines. Depending on its structure and on the reaction conditions, a compound of the last type might be oxidised further to an amide or might cleave to a mixture of a secondary amine and a carbonyl compound.

Recent work by N. J. Leonard and his co-workers(1) had shown that mercuric acetate in dilute acetic acid was an efficient dehydrogenating agent for many cyclic tertiary amines. The enamines formed were often best isolated as their crystalline perchlorates,

$$> NCHCH < \longrightarrow > NC{=}C < \longrightarrow$$

$$[\,> N{=}\overset{|}{C}CH <\,]^{+}\ ClO_4^{-}$$

$$\xrightarrow{CN^-} > \overset{|}{N}C(CN)CH <$$

and these salts could serve as starting materials for further syntheses such as the preparation of cyano-amines.

Side-chain alkyl groups in many mono- and dialkyl-anilines could be oxidised by manganese dioxide(2). These reactions, which have been carried out by stirring a solution of the amine in chloroform with the dioxide, usually took one of the following courses: (a) amide formation, (b) dealkylation with formation of an aliphatic aldehyde, or (c) dehydrogenation followed by oxidative cleavage of the resultant enamine.

Reaction path (a) was exemplified by the oxidation of dimethylaniline to N-methylformanilide. Monomethylaniline also gave the corresponding formyl compound.

$$Ph \cdot NMe_2 \xrightarrow{a} Ph \cdot NMe \cdot CHO$$

$$Ph \cdot NHMe \xrightarrow{a} Ph \cdot NH \cdot CHO$$

The oxidation of diethylaniline provided an example of conversion (b). A side reaction in this case was the formation of a small amount of N-ethylformanilide by

$$Ph \cdot NEt_2 \xrightarrow{b} Me \cdot CHO + [Ph \cdot NHEt] \longrightarrow Ph \cdot NHCHO$$

$$\downarrow c$$

$$[Ph \cdot NEt \cdot CH : CH_2] \longrightarrow Ph \cdot NEt \cdot CHO$$

reaction path (c).

Here there was evidence, stated Mr. Henbest, to suggest that the reaction proceeded *via* the enamine shown. That enamines were cleaved by manganese dioxide was shown by the oxidation of NN-dibenzyl-styrylamine, $(PhCH_2)_2N.CH:CH.Ph$, to N-formyldibenzylamine and benzeldehyde.

If an alkyl group was flanked suitably by two amine groupings, conversion (c) became the main reaction. For example, NN′-diphenylpiperazine gave NN′-diformyl-NN′-diphenylethylenediemine, the overall process being oxidative cleavage

$$PhN(CH_2CH_2)_2NPh \longrightarrow$$

$$PhN(CHO)CH_2CH_2(CHO)NPh$$

of a carbon-carbon single bond.

Good yields of secondary amines and carbonyl compounds could only be obtained from the very ready reactions of tertiary amines with N-bromosuccinimide if appropriate experimental conditions were used.(3) The reaction between equimolar proportions of tri-*n*-propylamine and the bromoimide in dilute solution in dioxan-water (9:1) led to di-*n*-propylamine and propionaldehyde in 80 per cent and 63 per cent yields respectively.

$$(CH_3CH_2CH_2)_3N + BrN(COCH_2)_2 + H_2O \longrightarrow CH_3CH_2CHO + (CH_3CH_2CH_2)_2NH \cdot HBr + HN(COCH_2)_2$$

Similar oxidation of tribenzylamine gave benzeldehyde and dibenzylamine in 90 per cent yields. The reactions could be followed by the development and disappearance of a coloured intermediate.

REFERENCES
(1) Leonard and co-workers, *J. Amer. Chem. Soc.*, 1956, **78**, 1984, 3457, 3462 and earlier papers.
(2) Henbest and Thomas, *J. Chem. Soc.*, 1957, 3032.
(3) Dunstan and Henbest, *J., Chem. Soc.*, 1957, in press.

Dehydrogenation by Manganese Dioxide

THE discovery by Morton, Goodwin and Ball (1) that vitamin A in petroleum solution was converted into retinene on shaking it with a suspension of hydrated manganese dioxide, provoked considerable interest in the use of this agent for the dehydrogenation of polyene alcohols; during the last ten years the range of its applications had been greatly extended. This was stated by Dr. R. M. Evans in a consideration of 'Dehydrogenation with manganese dioxide'.

It has been shown that, on shaking polyene alcohols with a suspension of hydrated manganese dioxide at room temperature, $\alpha\beta$-unsaturated primary and secondary alcohols, dissolved in neutral inert organic media, are efficiently converted into the corresponding aldehydes or ketones. This reaction occurs whether the unsaturation is part of an olefinic, an acetylenic, an aromatic or an alicyclic system. Under the same conditions Δ^5-3-hydroxy steroids yield $\Delta^{4:6}$-3-ketocompounds, but $\alpha\beta$-tertiary alcohols and saturated alcohols are substantially unaffected.

The selective action of hydrated manganese dioxide and the mild conditions employed made it particularly suitable for dehydrogenating unstable polyen- and polyenynols and for selectively oxidising allylic hydroxyl groups of polyhydroxy compounds, remarked Dr. Evans. The reaction could also be used as a test for the presence of $\alpha\beta$-unsaturated primary and secondary carbinol groupings.

At High Temperatures

At higher temperatures (e.g. 80°C to 120°C) hydrated manganese dioxide was less selective in action and could be used for a much wider variety of dehydrogenations; saturated alcohols, for example, were readily oxidised, α-ketols and vicinal glycols were cleaved to give lower carbonyl compounds and α-hydroxy acids yielded aldehydes or ketones.

Hydrated manganese dioxide was not a well-defined compound, and its preparation had to be carefully controlled to ensure consistent activity. It could be conveniently made by the oxidation of manganese sulphate with potassium permanganate in aqueous solution under either acidic (1,2) or alkaline(3) conditions. The products from both reactions were highly active; in Dr. Evans's experience the dioxide precipitated under alkaline conditions was the more efficient for dehydrogenating $\alpha\beta$-unsaturated alcohols, and that precipitated under acidic conditions more effective for preparing $\Delta^{4:6}$-3-ketosteroids. A third form of active manganese dioxide had been prepared by pyrolysis of manganese oxalate or carbonate(4); it had not been used as widely as the two precipitated forms.

Suitable solvents for the reactions carried out at room temperatures were light petroleum, ether, chloroform, benzene and acetone; at higher temperatures water or pyridine could be used. A proportion of about 10 parts by weight of dioxide to one part by weight of substrate had been most frequently used.

The mechanism of the reaction was obscure, said Dr. Evans, as the activity of the hydrated manganese dioxide precipitated under alkaline conditions was greatly influenced by its degree of hydration, and the dehydrogenation of the substrate resulted in reduction of a part of the dioxide to a lower valency state. Further information was needed for understanding of the reaction process.

REFERENCES
(1) Morton, Goodwin and Ball, *J. Biol. Chem.*, 1948, **42**, 516.
(2) Mancera, Rosenkranz and Sondheimer, *J., Chem. Soc.*, 1953, 2189.
(3) Attenburrow, Cameron, Chapman, Evans, Hems, Jansen and Walker, *J.*, Chem. Soc., 1952, 1094.
(4) Harnfeist, Bavley and Lazier, *J. Org. Chem.*, 1954, **19**, 1608.

Essay Prizes Presented at RSA Ceremony

PRIZES in the *Research* and *Sunday Times* essay competitions were awarded by Lt.-Gen. The Lord Weeks at a ceremony held at the Royal Society of Arts on 4 November. The Waverley Gold Medal went to Mr. I. E. Newnham, CSIRO, Melbourne, for 'Zirconium for nuclear reactors'; second prize to Mr. E. R. Stables, Ministry of Supply, for 'The skid wheel' and prize to an author under 30 to Dr. W. I. Stephen, University of Birmingham, for 'Ring microchemistry—a new analytical technique'.

The first *Research* prize for schools went to Mr. P. Day, Maidstone Grammar School, for 'Gas chromatography in a school laboratory' and the second prize to Miss N. Leys, St. Paul's Girls School, London, for 'The effects of antibiotics on the germination and growth of cress'.

Sunday Times prizes were awarded for essays illustrating the problem of communication between the scientific and non-scientific worlds and suggesting means of solving it. First prize went to Mr. T. L. Cottrell, Imperial Chemical Industries, for 'The communication of science', and second prizes to Dr. G. D. Archard, Associated Electrical Industries, for 'A scientist's job' and Mr. G. R. Schrager, University College, London, for 'Science and Society'.

Manchester Industrial Efficiency Show

THE Industrial Efficiency and Productivity Exhibition which opened in Manchester from 5 to 16 November is sponsored by the Institution of Works Managers.

Exhibitors include Baird and Tatlock (London) Ltd., who showed their Analmatic automatic titration equipment for process control, and included on their stand the Analmatic Karl Fischer apparatus for the automatic and consistent determination of moisture content. The new BTL wide range oven which can be used over the range 30-300°C as both a static and a fan-circulated oven, was also on view.

Elliott Brothers (London) Ltd., had a selection of instruments and control equipment from their extensive industrial range, including several examples of American-designed equipment now being manufactured by the company under licence.

The John Thompson Group displayed their work in connection with nuclear power, sewage plant and effluent disposal.

The UK Atomic Energy Authority had as main features, models of the Calder Hall and the Dounreay establishments.

Northide Ltd., Hyde, Ches., specialists in industrial protective wear, included North p.v.c. gloves and garments for protection when handling chemicals, acids, oils, greases, alkalis, solvents etc. Also shown were p.v.c. non-stick waterproof clothing and leather safety footwear and gloves.

Parmelee (GB) Ltd., specialists in the manufacture of industrial eye protection, displayed their latest products, the Airflow and Thrift Flex. In both these goggles the distance between face and lens is made as great as possible thus facilitating a rapid change of air within the goggles by Air Flow ventilation.

Powell and Co., showed new and specialised equipment for handling drums, barrels, carboys etc. Smiths Industrial Instruments Ltd., exhibited a wide range of devices designed for protection and control of industrial processes, and Wilkins and Denton Ltd., had a comprehensive display of their well-known Totectors safety footwear.

Speakers at a programme of talks held in conjunction with the exhibition included Mr. J C. B. Nicol, the deputy work study manager of the Billingham division of Imperial Chemical Industries Ltd., who spoke on 'Incentives for maintenance workers.'

Lawes Chemical Sponsoring an Agricultural Conference

Between 600 and 1,000 farmers and agricultural merchants are to attend at Reading on 21 November a conference sponsored by Lawes Chemical Co. which will discuss the future of British agriculture.

The panel of experts, headed by Sir William Ogg, will include banker Colonel John Thompson, a director of the Agricultural Mortgage Corporation, for among the items to be considered is finance of the industry.

Managing director of Lawes Chemical Co. is Mr. William B. Davis.

APPLYING POLAROGRAPHY TO AUTOMATIC CONTROL

TWO topics were discussed at a meeting of the Polarographic Society on 7 November. The first was the possibility of applying polarographic techniques to automatic control processes.

Mr. W. J. Parker of Mervyn Instruments mentioned the difficulty associated with polarographs which present the wave in a derivative or peaked form. The position of the peak varied in some cases due either to a variation of half wave potential with concentration or to a change in IR drop as the solution varied. A system of monitoring which used a fixed applied potential at a peak might give trouble in these cases. A further problem was the maintenance of a stable reference electrode.

Dr. H. Schweitzer suggested the possibility of overcoming this by having several reference electrodes, each of which could be switched in at suitable pre-set intervals. Another possibility, he said, was the use of one polarograph to control several process streams by suitable rotary switching. The time interval for doing this could be made as short as the system permitted.

According to Mr. G. Russell of Ilford Ltd., the polarographic method would have to compete with several non-destructive methods such as spectroscopy, isotopes or nuclear magnetic resonance. He quoted examples of cases where the polarographic method was not acceptable.

The second subject discussed was the use of a novel electrode in Dr. G. J. Hills' department at the Royal College of Science, London. Describing the electrode, Mr. J. E. Oxley said that it had been developed for use in fused salts, but was also being tried out in aqueous solutions. The dipping electrode consisted of a platinum wire fused into glass, ground smooth and surrounded by a sheath. Between the glass and the sheath an inert gas was bubbled at a known rate. This resulted in a make and break effect. The current-voltage curves obtained resembled normal polarograms and metal ions displayed similar half wave potentials. A lively discussion ensued on the electrode process involved and on the current determining factors during the make period.

Knapsack-Griesheim Develop Process for Chloroprene Manufacture

FOR a few months now, Knapsack-Griesheim have been producing chloroprene by their own process; the first time that this important raw material has been manufactured on a technical scale by any other company than Du Pont. The process involves dimerising acetylene to monovinyl acetylene and then reacting with HCl. (This process was mentioned in CHEMICAL AGE, 5 October, page 560.)

Vinyl acetylene is difficult to process due to its readiness to decompose, while chloroprene, with its thousandfold greater polymerisation speed than butadiene and its tendency to uncontrollable polymerisation reactions, requires special precautions during synthesis and purification. Both compounds also pose major corrosion problems and thus production of chloroprene is among the most difficult of technical processes.

Knapsack makes vinyl acetylene together with acrylonitrile by its own (non-specified) process which involves a copper chloride catalyst. The yield of both materials is more than 90 per cent and thus greater than the 80 to 85 per cent previously achieved in manufacture of either separately.

From the engineering aspect, it is particularly interesting to note that in purifying the crude chloroprene Knapsack use distillation columns which are particularly suited for materials with a tendency to polymerise and which have previously hardly been used for such purposes.

The whole monthly output of 300 tons of chloroprene is shipped by tankcar to Farbenfabriken Bayer AG who polymerise it according to a process of their own devising.

Plans for an acrylonitrile plant, with a monthly production of 600 tons in the initial stage, have been finished by Knapsack. The entire output of this plant will also be taken up by Bayer, for the production of Dralon, a synthetic poly-acrylonitrile fibre.

Du Pont to Handle UK Neoprene Sales

THE formation is announced of the Du Pont Co. (United Kingdom) Ltd., 5 Charles II Street, London SW1, to manufacture and sell neoprene in the UK and European markets. This has involved modifications of the arrangments under which Durham Raw Materials Ltd. have been the sole distributors of neoprene in the UK.

From 1 January 1958 sales of neoprene will be made in the name of Du Pont Co. (UK) and Durham Raw Materials will act as sales agents. Durham Raw Materials will surrender the agency on 1 January 1959 and Du Pont Co. (UK) will assume full control of all neoprene sales.

The change has been made by E. I. Du Pont de Nemours as a result of their decision to manufacture neoprene in the UK and, in accordance with their normal policy, to handle sales from this plant.

According to Durham Raw Materials the changeover has been made on terms which are acceptable to both parties.

Hydrogen Sulphide Determinations using a New Apparatus

APPARATUS for the measurement of hydrogen sulphide relies on the production of a lead sulphide stain on a lead acetate test paper. It is necessary to control the gas flow at a constant rate (usually 0.5 cu. ft. hr.) Various means to control the gas rate have therefore been tried.

Following a prolonged test under works conditions, a complete apparatus

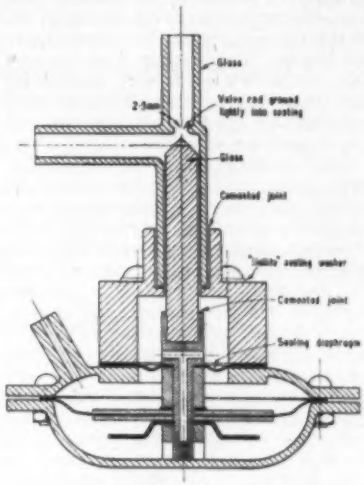


Diagram of the governor

was developed, incorporating a differential governor with a robust glass valve. The apparatus was designed and developed in the Brentford laboratory of the North Thames Gas Board by C. A. Hendley.

The gas enters through a moisture trap and glass tap into the top of the governor valve (see diagram). The outlet of this valve is connected to the inlet of the control capillary, and also to the reservoir of the flow gauge. The gas passes from the capillary to the saturator, and thence to the test paper held in a clamp on the front of the apparatus. To provide the differential pressure, a pressure point from the outlet of the capillary tube is connected to the other side of the governor diaphragm.

Molten Salt Baths

Salt baths useful in the heat treatment of metals, particularly uranium, are described in a UK Atomic Energy Authority patent application (No. 29689/56) in the name of E. H. Cooke-Yarborough. A salt bath having a melting point in the neighbourhood of 400°C consists of a mixture of the carbonates of potassium, sodium and lithium. The mixture, potassium carbonate 36 per cent, lithium carbonate 32 per cent, and sodium carbonate 32 per cent, has a melting point of 405°C and it may be employed, the application states, for treatments at temperatures up to 820°C.

ADVANCES REPORTED IN LOW TEMPERATURE RESEARCH

1957 Cryogenic Engineering Conference

WITH more than 500 engineers and scientists in attendance, the 1957 Cryogenic Engineering Conference met at the Boulder Laboratories, US National Bureau of Standards, in August last. The low-temperature field continues to attract increasing attention from industry and defence. The 44 papers dealt not only with recent low-temperature engineering techniques and experimental discoveries, but also with the theoretical problems of low-temperature research.

Although the process of low-temperature refrigeration and gas separation was worked out nearly a half century ago, important improvements are still being developed, conference papers brought out, with the result that liquefaction processes are becoming more efficient and less expensive. The most striking recent illustration of this fact was described in a series of papers on the use of the catalyst, hydrous-ferric oxide, to convert liquid hydrogen from the ortho to para state during liquefaction. As a result, the liquid is not evaporated by conversion which would otherwise take place in the storage vessel.(1)

C. R. Class, R. P. Spero, and G. E. McIntosh (Beech Aircraft Corp.), told of a theoretical study that showed how catalysts, when properly located to convert ortho- to parahydrogen in the gas phase of a parahydrogen liquefaction cycle, are more effective in increasing yield than either minor-cycle modification or major-expansion engine improvement.

Design Data

Design data for ortho-parahydrogen converters were presented by D. H. Weitzel, C. C. VanValin, and J. W. Draper of the NBS Cryogenic Engineering Laboratory. They pointed out that the most important variables in such designs are the conditions of temperature, pressure, feed composition, and space velocity (or contact time) under which the conversion proceeds.

W. A. Wilson of NBS in co-operation with D. H. Weitzel, then showed the favourable comparison between the laboratory-scale studies and results obtained in the large Bureau liquefier when a vapour-phase converter was used operating in a 71°K bath. It was pointed out that conversion at higher temperature provides increased liquefaction-cycle efficiency.

A gas liquefier of non-conventional design and modest cost which can produce five quarts of liquid air an hour was described by T. W. Schaffers (North American Philips Co.).

In the discussions devoted to cryogenic applications, R. E. Brown (Navy Bureau of Aeronautics) expressed the opinion that helium could be conveniently liquefied at production plants so it could be shipped by air or tank cars to points of use. The cost of transporting helium as a liquid, he pointed out, is about one-fifth the cost of transporting the same amount of it as a high pressure gas. The US Navy Department is critically concerned with achieving the most economical production and transportation of helium since it requires large quantities for a wide variety of uses including welding and airship inflation, and for its role in the nation's missile programme.

For some time the Bureau has been investigating the technical feasibility of such a plan as that proposed by Mr. Brown. The Boulder Laboratories have worked out designs for a railroad tank car capable of transporting 60,000 l. (15,000 gal.) of helium as a liquid.

At Air Products Inc., a large-scale liquid oxygen and liquid nitrogen unit has been developed to satisfy requirements of the Air Force missile programme, according to a paper delivered by W. J. Scharle. The unit has a high efficiency with consequent low operating cost, minimum utility requirements (including no water consumption) and maximum mobility compatible with large-scale liquid production. Production rate of the unit is 56,000 l. per day of liquid oxygen plus 8,000 l. per day of liquid nitrogen, each at 99.5 per cent purity.

Unattended Oxygen Plants

W. W. Aton (Linde Co.) told of unattended oxygen plants that range in capacity from less than 10 million cu. ft. to more than 100 million cu. ft. per month. These plants function in conjunction with liquid oxygen storage supply facilities that consist of a storage tank and the required auxiliaries for pressurising, vaporising, and delivering gaseous oxygen into the customer's pipeline.

Solution of a problem that has challenged cryogenic scientists for some time was announced by S. Greenfield of Rocketdyne. Rocket engineers there have found a solution to the problem of keeping the pressurising gas, nitrogen, from mixing with the liquid oxygen used as a propellant. Working under an Air Force contract, Rocketdyne has designed a perforated inlet tube that slows down the nitrogen as it is diffused into the liquid oxygen chamber. Instead of mixing with the liquid oxygen, the nitrogen bounces against the top of the tank and then gently blankets the liquid.

It was stated that 10 to 20 times less dilution takes place with the new inlet tube. This may increase the range of long-range rocket-powered missiles by as much as 30 per cent. It is also planned to try replacing the perforated tube with a tube made of metal mesh; the indications are that this tube will be even more effective.

Fourteen papers were delivered on cryogenic equipment and included discussions of the use of liquid helium in an atomic reactor in order to study radiation effects at extremely low temperatures; piston-type high pressure aircraft cryogenic pumps; and a cryostat for liquid nitrogen cooling of rocket-borne photomultiplier tubes.

V. E. Isakson, C. D. Holben, and C. V. Fogelberg (Beech Aircraft Corp.) reported on a large-size, non-refrigerated vessel that stores and transports liquid hydrogen. This vessel is insulated with evacuated powders and does not use a radiation shield. Heat leak calculations predict loss rates of about 2 per cent per day; measured values are somewhat less. The dewar is mounted on a semitrailer chassis, but it can be removed where a skid-mounted dewar is required.

The fact that no one thermometer is suitable for the entire temperature range of 1° to 300°K, led to a study reported by R. D. Goodwin of the Boulder Laboratories. His experiments show that thermometer power may be reduced by using unsymmetrical resistance bridges, by using specific bridge circuits in conjunction with various types of thermometers, and by matching the bridge source and detector input impedances.

Cryogenic Properties

In one of more than a dozen papers on the topic of cryogenic properties, one by R. M. McClintock and M. J. Hiza (NBS) described the properties of a filled-epoxy resin adhesive which has been found capable of holding light metals together with a strength of 800 p.s.i. at a temperature of 20°K. The research was necessitated when design of a liquid-hydrogen cooled electromagnet being developed at Los Alamos Scientific Laboratory required that copper coils be joined with a resin. These coils are subjected to sudden and extreme decreases in temperature, so that a resin was needed that would contract in the same ratio as the copper parts they bonded together.

S. C. Huntley (NACA) discussed the problem of heat leak associated with increase in pressure when cryogenic liquids are enclosed in a container. He reported on an experimental study that determined the factors controlling pressure rise in a closed liquid-nitrogen container. Liquid and vapour temperatures were measured in a 30 in. by 93 in. dewar as the container was allowed to pressurise with time. Heat leak rate was controlled by varying vacuum pressure in the jacket of the dewar. Liquid level was varied from one-third to two-thirds of container capacity.

It was shown that, because of free convection, a liquid temperature gradient exists which becomes more severe with time; the free surface temperature controls the pressure; and, mixing the liquid extended the time required to reach limiting pressure. It was also shown that the temperature gradient exists in the vapour and mixing the vapour may result in a substantial increase in pressure.

It was announced at the close of the sessions that the 1958 Cryogenic Engineering Conference will be held 3 to 5 September at the Massachusetts Institute of Technology. The invitation for the meeting was extended by Professor S. C. Collins, head of the MIT cryogenic engineering laboratory.

(1) Catalyst for parahydrogen production, *NBS Tech. News Bul.* 41, 154 (Oct. 1957).

Overseas News

THIRD-QUARTER RESULTS SHOW US CHEMICAL INDUSTRY UNDER PRESSURE

RESULTS for this year's third quarter for major US chemical companies show that sales were higher and profit more, in general, compared with those of the same period last year. At the same time, however, the companies were still faced with rising operating expenses, expanded capacity, and a levelling off of the national economy.

Of the larger US chemical companies, American Cyanamid, Dow Chemicals and Monsanto Chemicals all report earnings up 20 per cent or more, compared with the same period in 1956. In comparing results with 1956, the effect of the steel strike and drought during the period should be remembered. Basic chemicals producers such as Hooker Electrochemical, Diamond Alkali and Pennsalt have had their earnings affected by higher operating costs and stiffer competition.

Manufacturers of ethical pharmaceuticals, such as Parke-Davis, Pfizer, Smith Kline and French, Merck and Norwich Pharmacal, all show sharp gains in sales from last year's levels.

Compared with chemical shares, which have dropped almost $400 million since the middle of July, pharmaceutical shares have held up well, losing only about 10 per cent.

Other points regarding chemical and allied products are that although sales are up about 6 per cent on the previous year, they have only gained 3 per cent from January this year. Also half of this rise is attributable to higher prices. Production too is reported to have levelled out. The Federal Reserve Board index of chemical production, at 185 in August, was one point only above its January level and has fluctuated from 182 to 185 all year.

A survey of opinions from some 200 economists suggests a moderate rise in business activities in 1958. The outlook for the following year is not optimistic, however.

Peru Fertiliser Plant on Stream in 1958

Production at the new US $7 million nitrogenous fertiliser plant now being built about four miles north of Calloa, Peru, for Fertilizantes Sinteticos SA (Fertisa) is expected to begin in the latter part of 1958. Surplus nitric acid will eventually be sold to the Belgian-Peruvian explosives plant south of Lima.

Plastics Factory in Rome

A new plastics factory, belonging to Societa' Lavorazione Resine (Solare) has been opened at Tor Sapienza, the industrial area of Rome.

New Australian Process for Permanent Pleats

A new process, SI-RO-SET, for making permanent pleats in wool fabrics, has been provisionally patented by the Commonwealth Scientific and Industrial Research Organisation. Perfected in the CSIRO wool textile research laboratories at Geelong, Victoria, the process consists of spraying a weak solution of thioglycollic acid on to the garment and then immediately steam pressing for a short period. The process is to be made available overseas.

Glascote's Spherical Glass-lined Reactor

A 500-gallon (nominal capacity) sphere-shaped reactor which is glass-lined and is designed to operate at 330 p.s.i. internal pressure and 250 p.s.i. in the jacket has been marketed in the US by Glascote Products Inc., Cleveland, Ohio.

Points of interest regarding this reactor include the following: the large capacity—the sphere shape permits the thinnest metal wall possible to contain a given amount of liquid under pressure—a shorter agitator shaft reduces drive maintenance and shaft bending, normally encountered in large volumes. There is one main seam thus making a minimum of welding. A ring-type support is provided. Higher vapourisation rates and less foaming are claimed for the reactor, owing to the larger liquid surface area. Glascote chemical-resistant, acid-alkali glass is used to line the reactor.

Microcellular Synthetic Rubber Developed

Claims to have developed a synthetic rubber with microcellular properties are made by Mr. George Tsai, a Hong Kong rubber technologist and member of the Institution of the Rubber Industry. The product is being used for the manufacture of slippers, of which 30,000 pairs are being turned out every month.

New Plastics Chemical

A new chemical compound, N_1N—diallylmelamine, developed by the American Cyanamid Co., US, is claimed to form not only curable resins from basic raw materials or monomers, but also to manufacture man-made fibres that can be dyed with acid dyes from acrylonitrile materials.

Currently being investigated are a number of potential industrial applications.

The new compound is shortly to be made available in experimental quantities.

US Oxygen Firm Plans Colombian Plant

Formation of a new gas company in Bogota, Colombia, has been announced. It will distribute natural gas in containers throughout the country. The company, in which Sear Roebuck of the US have a large interest, have purchased all the gas distributing equipment formerly owned by the International Petroleum Co. and Esso Colombiana.

It is also announced that the Southern Oxygen Co., Washington, DC, US, will shortly set up a factory in Colombia, with a capital of Ps2 million (£120,000), for the production of hydrogen, carbon dioxide, heavy acids and glycerine. Colombia is now reported to be self-supporting in sulphuric acid.

Dutch Turnover Tax on Imported Chemicals

The following changes in the Netherlands turnover tax surcharge on imported goods were effected from 15 October: Chloromethane, increased by 3 to 5; dichlorodifluoromethane 4.5 (new item); lactic acid increased by 1 to 4; silicic acid (silica gel) reduced by 1 to 2; calcium lactate up 0.5 to 2.5; ethyl lactate up 1 to 4.

German Interest in Guiana Silica Deposits

Interest in British Guiana's silica deposits by the German company Ernest Leitg and Co. is reported. A representative of the company has been investigating the industry and the possibilities of setting up a glass industry. Results of experiments carried out using the local sand for making items of glassware have been considered promising.

New Plant for Canadian Paper Industry

The US firm of Pennsalt Chemical Corporation, Philadelphia, have taken an option on a site on the shore of Vancouver harbour, Canada, and are to build a $10 million plant. They will manufacture chemicals for British Columbia's pulp and paper industry. The company has plants in 20 US cities, and in South America and Mexico. Another is being built at Oakville, Ontario. Pennsalt recently incorporated a Canadian subsidiary, Pennsalt Chemicals (Canada) Ltd.

Production Possible at Sicilian Oil Well

Experiments carried out in the British Petroleum laboratories in London may make possible the pumping of petroleum from a mine discovered by CISDA, a BP associate, at Vittoria, Sicily, in 1953. Initially the petroleum from this mine was thought to be useless because of its high viscosity and large sulphur and asphalt content.

6 Per Cent Rise in US Plastics and Resins Production

In the first eight months of this year, US plastics and resin production exceeded 2,700 million lb., 6 per cent higher than in the same period in 1956.

Vinyl and vinyl copolymer resins production in this period totals 543 million lb., an 11.7 per cent increase on 1956 figures. Polythene production is second, totalling 437 million lb., a 22.8 per cent rise, and it is suggested that the end of the year figure will be more than 600 million lb. Most of this total is composed of conventional-type polythene, with only a small amount of the Ziegler- and Phillips-type material.

Polyester resins have shown the largest relative growth; more than 30 per cent to date. These resins are expected to be in the over 100 million lb. class by the end of the year. The eight-month production figure is 63 million lb.

Downward trends have been shown this

year, however, by some US plastics. In particular, phenolic and other tar acid resins are down 7.3 per cent with a production of 319 million lb. Loss has been noted especially in phenolic moulding materials. Production and sales of nitrocellulose sheets, rods and tubes are down. Due to decreases in production of styrene protective coating resins, production of styrene resins at 421 million lb. as a group is below average by 0.2 per cent. Polythene is expected to take over from this group.

Coating resins, which include epichlorhydrin, acrylic and silicone coating resins are up by 28 per cent compared with the first eight months production in 1956. Adhesives and vinyl coatings have also had increased sales this year.

Fertiliser Plant in Brazil

The Brazilian Companhia Rio Grandense de Adubos has inaugurated a new factory in Porto Alegrem in Rio Grande do Sul. Capacity is 50,000 tons of hyperphosphate, 60,000 tons of mixed fertilisers, and 40,000 tons of superphosphate.

Hong Kong Sales Office Opened by Dow

A new foreign sales office in Hong Kong has been opened by Dow Chemical International Ltd., an export subsidiary of The Dow Chemical Co. Mr. Eric C. Huggins has been appointed acting manager of the office.

In addition to the two Far Eastern offices, Dow maintains a resident sales supervisor in Sydney, Australia.

Large Boron Output Forecast in US

Production levels of boron (hydrogen high-energy fuels) compounds will soon be substantial in the US. Callery Chemical Co. are scheduled to have a new $4 million (£1,421,000) plant in operation by next spring, which, according to director of research, Dr. G. Huff, will produce 'practical quantities of the new fuel.' Construction of a $32 million plant for production of the fuel is planned for next year. This plant would come into operation in January 1959.

Ciba's US Epoxy Resin Plant

Ciba is to build a new 18 million lb. plant to make epoxy resins at Toms River, New Jersey. The new unit will include development laboratories and is expected to come on stream in mid-1959. The new plant will replace the Kimberton plant where Ciba's resin and plastics activities are now centred.

New Ethylene Oxide Resin Family

Union Carbide have introduced a new class of water-soluble resins—high polymers of ethylene oxide—marketed under the trade name Polyox. The new plastics can be cast, calendered, or extruded into tough flexible film and is stated to have greater thickening properties than competitive products.

The new resins are said to have many of the properties of polythene, but differ in water solubility and melting point (65°C). Molecular weights are of the order of two to three million. Additional properties are low-moisture take-up in dry form, resistance to oil and greases in absence of water, and compatibility with such polymers as starch and polyminyl acetate. The resins are soluble in acetic acid, acetonitrile, chloroform, hot aromatic hydrocarbons, and hot carbon tetrachloride. It is also stated that the resins resist biological attack.

Applications include thickeners for colloidal systems; stabilisers and thickeners (textile printing paste and rug backing, and adhesives, toothpastes, and cosmetics); 'one shot' packages for items such as agricultural chemicals, inks and detergents, where the whole unit chemical and resin, can be dissolved in water as required.

Polyox resins are being produced on a pilot plant scale at Union Carbide, South Charleston, West Virginia, US. Commercial production is scheduled for next year with a 'major plant' outlined for 1960.

Initial cost of the resins will be $1.50 per lb., but the company hope the price will come down into the 75 cent range, and ultimately to even 35 cents. Three grades of resin will be available.

Contract Awarded for Brazilian Oil Refinery

The National Petroleum Council of Brazil has authorised Petrobras to install a 90,000-barrel refinery in the town of Duque de Caxias, in the state of Rio de Janeiro. It is believed that a construction contract has been granted to the Foster-Wheeler Corporation of America.

Rio Tinto to Set Up Plant at Banbury

Australian Minister for Works, Mr. Tonkin has announced at Bunbury, Western Australia, that a chemical industry will probably be started at the port by a large British company.

Reports suggest that the company may be Rio Tinto and Sulphur, for the company are known to have investigated the large ferro-sulphur deposit at Koolyanobbing. Rio Tinto is already in the uranium mining industry at Mary Kathleen in Queensland.

The possibilities are being considered of the company establishing a sulphuric acid plant at the site of the deposit, using the acid as the basis for a chemical industry at Bunbury, which can supply also heavy mineral sands in the form of ilmenite, monazite and zircon.

Formalin Production to be Increased in Australia

Plans have been completed by Imperial Chemical Industries of Australia and New Zealand to step up formalin production at their Botany Bay, New South Wales, plant.

As a result of overseas investigations by the company's chemists, a new process will be introduced enabling efficient production of several grades.

Apart from its uses in the plastics industry, formalin is of importance for the treatment of foot rot in sheep.

Rome Company Wants UK Agencies

It is reported that Deisan SRL, Via Delle Carrozze 55, Rome, suppliers to hospitals, are anxious to represent UK manufacturers of pharmaceutical, chemical and other products of interest to hospitals.

Chilean Nitrate and Iodine

Production of nitrate in Chile during the first five months of 1957 totalled 553,300 tons, compared with 601,000 tons in the corresponding period of 1956—a fall of 8 per cent. Iodine showed an increase of 71 per cent over the same periods, reaching 555 tons in January-May 1957, compared with 324 tons in the first five months last year.

Simple, Fast Method Devised for Detecting Mercury Poisoning

A PRODUCTION line method of detecting mercury poisoning in industrial workers has been devised by a research chemist at the Brooklyn Jewish Hospital, Brooklyn, New York, Sidney Nobel and his wife Deana. The new technique also promises to provide medical science with a new tool for understanding congestive heart failure.

More than 4 million lb. of mercury are used annually in the US. About one-third of this total goes into the manufacture of agricultural chemicals and a large percentage is used for the production of electronic and electrical equipment. Years ago, before the use of mercury was largely discontinued by the felt manufacturing industry, mercury poisoning was a common occupational disease among felt hatters and was known as 'hatters' shakes', so-called because trembling hands were characteristic of the victims.

The new detection method was evolved after a study of chemicals that are used to convert mercury present in urine into a form that can be easily recognised. Use of the agents which eliminate the older time-consuming process, makes it possible to run as many as 20 to 30 tests in a single day as compared with approximately six tests possible by ordinary methods. Industrial workers could be screened virtually on an assembly line basis as a result of the new method, Mr. Nobel said.

To arrive at the new method, the Nobels treated urine with copper salt and hydrazine as a reagent to convert the mercury in the urine to metallic mercury. Then the mercury could readily be oxidised by potassium permanganate to the mercuric state, thus eliminating the older, time-consuming process of boiling the urine in strong acids for several hours. The final estimation in the new process is made with a standard analytical technique employing dithizone, which forms a golden yellow colour in the presence of a mercuric ion.

This simpler method may provide a valuable tool in the study of the way in which mercury assists the kidney in excreting water when mercurial diuretics are given to patients with edema, particularly in congestive heart failure.

W. GERMAN OUTPUT EXPANSION SLOWS, BUT PRICES STABLE

LATEST available figures indicate a considerable slowing-down of the output expansion in the West German chemical industry. Prices, which tended to decline earlier this year, however, are now stable. While the average increase in the production of chemicals early this year was still not far short of 20 per cent compared with 1956, a comparison of June-August, 1957, with the corresponding three months of 1956 reveals an output increase by 5 per cent only for inorganic and 7 per cent for organic chemicals. The output of sulphuric acid rose by 7½ per cent, chlorine by 12, caustic soda by 8½, calcium carbide by 5, methanol by 17½, ethylene oxide by over 25, and acetic acid by 2 per cent. Soda producers had to cut their output by 6 per cent.

These production gains must be viewed against a background of considerable capacity extensions in recent years. As the expansion of home demand proceeded somewhat more slowly than anticipated, it has been possible to speed up deliveries, a matter of some importance in some foreign markets. Exports of chemical and allied products in the first half of this year were fully 20 per cent up on the first six months of 1956, thanks largely to substantially higher shipments of plastics, pharmaceuticals and dyestuffs. Chemical imports into the Federal Republic also showed a 20 per cent increase over the corresponding period of 1956, and those of dyestuffs a 25 per cent rise which is attributed to liberalisation measures.

Higher Exports Expected

The percentage increase in home sales of West German chemical products in the first half of 1957 may have been slightly smaller, and for the second half of this year it is expected to be substantially smaller, as indicated by the output figures mentioned above. Nevertheless, two of the three big combines, Farbenfabriken Bayer and Farbwerke Hoechst, have already announced that they expect sales in 1957 to be 15 per cent higher than in 1956.

Smaller manufacturers will find it difficult to equal this expansion of sales over the whole year, largely because shortage of investment capital is slowing down their plant extension plans. Even the leading producers hold the view that future additions to West German production will tend to reduce imports quite as much as increase exports. While West German output capacities were inadequate, additional imports were needed and accepted even at relatively high cost, the more so as the authorities, faced with an embarrassingly high payments surplus, saw no cause to hamper the import trade. With new capacities coming into operation in those sections of the chemical industry which were hitherto unable to meet all home demands, the scope for imports is likely to diminish. Raw materials as distinct from intermediates and finished products account for about half of West Germany's chemical imports at present; there has been an above-average rise in imports of pyrites and phosphates.

An important barter deal in German nitrogen fertilisers and Egyptian cotton has been negotiated by a West German group led by BASF, Farbwerke Hoechst and Ruhrstickstoff. This group will supply Egypt with fertilisers to the value of DM 25m. (£2.27m.). The quantity of cotton to be delivered in return will be rather smaller than the DM value of fertiliser shipments suggests, for not only will 15 per cent of the price of the cotton be paid in free German currency but the German fertilisers suppliers will help the Egyptian importers to bear their loss on the cotton which has to be sold abroad below the official Egyptian currency equivalent. Part of this loss on the cotton part of the deal will be passed on to Egyptian fertiliser users, and part will be born by the German chemical interests concerned in the transaction.

Farbwerke Hoechst announced recently that the first complete section of the petrochemicals plant will be finished before the end of this year. The second stage of the work on the Trevira polyester fibre is approaching completion. The heavy water plant is to go on stream shortly. Additional montan wax supplies are being made available for the production of waxes. A new cellulose acetate plant will be put in commision by Kalle and Co., Wiesbaden, later this year. At the same time it was announced that the board has approved a new capital programme involving investments of DM 200m. (£18m. approx.) the same as this year, in 1958.

NBS Reports Successful Experiment in Large-Scale Helium Liquefaction

LIQUEFACTION of helium in large quantities now seems to be possible, reports the US National Bureau of Standards. This has been shown from a recent experimental run at the Boulder (Colo.) Laboratories of one of the Bureau's large hydrogen liquefiers. The test, under the direction of Victor J. Johnson of the NBS Cryogenic Engineering Laboratory, resulted in about 125 l. of liquid helium being collected in the liquefier in just over one hour of liquefaction with the plant operating at two-thirds capacity. Liquefaction rate averaged about 120 l. per hour.

When operating at full capacity at Boulder conditions (four-fifths of an atmosphere ambient pressure due to 5,400 feet altitude), the plant can liquefy about 320 l. of normal liquid hydrogen per hour. The simple Joule-Thomson liquefaction process is used with precooling supplied from liquid nitrogen boiling at about 65°K.

To modify the liquefier for liquefaction of helium instead of hydrogen, the liquid hydrogen transfer line from the bottom of the liquefier to the storage dewar is removed from the bottom of the liquefier and reconnected to the precooling chamber. Suitable precautions are taken regarding insulation of the line to prevent undesirable temperature gradients and improper heat transfer in the liquefier. No changes are made in the control instruments, valves, or heat exchangers except to note changes in instrument calibration for liquid and gaseous helium.

The liquefier is cooled to about 75°K by circulating gaseous helium precooled with liquid nitrogen. The liquid nitrogen supply is then shut off, and as soon as that remaining in the liquefier has evaporated, liquid hydrogen is admitted to the precooling bath. About an hour is required to finish cooling the liquefier to the point that liquid helium starts to collect. A little more than 200 l. of liquid hydrogen are said to be required. During the liquefaction period about 1.5 l. of liquid hydrogen are required as a precoolant for each litre of liquid helium collected. About 190 l. were used to liquefy the 125 l. collected.

Actual liquefaction yield (fraction liquefied) in the experimental run was about 12.1 per cent. Two compressors were used, each with 250 c.f.m. at intake conditions (12.8 p.s.i. at 70°F). The total gas circulated was 4.55 lb. per minute, which is equivalent to 990 l. per hour of liquid helium. The fraction liquefied then was 120/990 or 12.1 per cent. With the use of three compressors, improved instrumentation, and control, the Bureau believes that a yield of 200 l. per hour could be approached.

'Oil for Britain' Exhibition at De La Rue House

AN exhibition 'Oil for Britain' is being staged at De La Rue House, 84/86 Regent Street, London W1, from 5 to 20 November (Sundays excepted), 9.30 a.m. to 7.30 p.m. daily, Saturdays 9.30 a.m. to 1 p.m., admission free.

Features of the exhibition are: The importance of oil to Britain, and to the individual, the origin of crude oil, exploration, drilling and production, transportation, refining, distribution and the various uses of oil. Regular film shows are being given during the course of the exhibition.

Import Duty on Methane

The Board of Trade are considering an application for the exemption from import duty of methane. Companies interested in this application should write to the Board of Trade, Tariff Division, Horse Guards Avenue, Whitehall, London SW1, not later than 26 November.

CHEMICAL PIONEERS

13 John Glover

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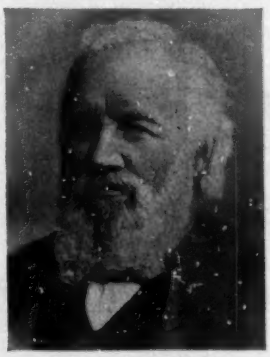
John Glover, like Muspratt, Tennant, Spence and Young, was one of the minor group of chemical industrial pioneers who emerged from the manual working class. The son of a working man in the humblest circumstances, John Glover was born in Newcastle on 2 February 1817. If he received school education of any kind, his biographer, J. T. Dunn, in 1903, was unable to ascertain particulars of it.

Apprentice Plumber

At the age of 13 he was apprenticed to a plumber. After seven years he duly became a journeyman in that trade, and for a further seven years he worked in the same trade. Early in his apprenticeship Glover acquired the habit of study. He always carried a book in his pocket and took every opportunity of reading. While much of this early reading was probably of a general nature, young Glover's active mind was soon touched by that remarkable wave of interest in science displayed by 'mechanics' in the 1830's. For some time Glover studied the elements of chemistry at the Mechanics' Institute in his native city. It was, no doubt, as a result of these studies that he decided, in 1841, to seek employment with Hugh Lee Pattinson in his chemical works at Felling-on-Tyne.

Glover's first duties at Felling were mainly concerned with maintenance of the chambers of the sulphuric acid plant. He turned his recently acquired chemical knowledge to useful purpose on this and other processes carried on in the works. Soon he persuaded Pattinson to give him a humble post in the laboratory. At this time alum was being produced at Felling Works and it was the practice to remove iron by addition of potassium ferrocyanide to the hot solution. Glover discovered that by carrying out this procedure on the cold solution a saving of about one-half of the costly ferrocyanide could be effected.

The tower, invented in 1827 by Gay-Lussac, was designed to reduce the costly waste of sodium nitrate by absorbing, in strong sulphuric acid, the nitrogen oxides in the exit gases from the chambers and returning these to catalyse further acid production. The amount of concentrated acid required to feed the Gay-Lussac tower was approximately equal to the normal daily off-take from the chambers; thus, where a Gay-Lussac tower was in operation about twice the usual concentrating capacity had to be installed, with consequent increase in fuel and maintenance costs. In Lancashire no Gay-Lussac towers were installed until 1869, and very few works had them on the Tyne: the saving in nitrate effected did not compensate for the increased costs of acid concentration. There was, too, the additional difficulty and cost



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● New director of research and development of the board of International Plastics is PROFESSOR EDGAR W. E. MORATH. Previously the professor was technical director of a group of companies concerned with forest products industries in France and Germany.

● The Davy Medal of the Royal Society has been awarded to DAME KATHLEEN LONSDALE, Professor of Chemistry and head of the department of crystallography, University College, London, for her work on the structure and growth of crystals. Professor Lonsdale is a member of the council of the Society for Visiting Scientists, chairman of the British National Committee for Crystallography and vice-chairman of the Atomic Scientists Association. She has published many papers and books on crystallography.

Laporte Build Plant for Hydrogen Peroxide

Preparations are being made at Laporte Chemicals' Baronet works, Warrington, Lancs, for the production of hydrogen peroxide by a process of autoxidation. New buildings are erected for the purpose and there will also be new plants for the production of sodium perborate and organic peroxides.

Gift from Dunlop

A donation of £1,000 has been made by the Dunlop Rubber Co. to the Production Engineering Research Association's fund for the development of a new workshop and laboratory.

Obituary

MR. ARNOLD WHITAKER, B.Sc., D.I.C., A.R.C.S., died on 9 November at the age of 64. Since 1946 he has been at the Building Research Station, Garston, as a senior experimental officer engaged on work on flue gases. He graduated in 1915 at the Royal College of Science, and until joining DSIR worked as a chemist for the Admiralty.

DR. FELIX SINGER died recently at his home in South Croydon. He was 69.

His reputation in the field of ceramics was international, and his work took him all over the world. He was a Fellow of the American Ceramic Society and the British Institute of Ceramics. He wrote many articles for the Press and published a number of books.

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● MR. GEORGE C. WELLS has been appointed president of Union Carbide International Co., division of Union Carbide Corporation. He succeeds MR. A. MACKENZIE who retires this winter after more than 40 years with the corporation.

● MR. ANDREW J. S. ELLIOTT and MR. ARTHUR G. GREWAR have been appointed directors of Scottish Agricultural Industries.

● New director of research and development of the board of International Plastics is PROFESSOR EDGAR W. E. MORATH. Previously the professor was technical director of a group of companies concerned with forest products industries in France and Germany.

● The Davy Medal of the Royal Society has been awarded to DAME KATHLEEN LONSDALE, Professor of Chemistry and head of the department of crystallography, University College, London, for her work on the structure and growth of crystals. Professor Lonsdale is a member of the council of the Society for Visiting Scientists, chairman of the British National Committee for Crystallography and vice-chairman of the Atomic Scientists Association. She has published many papers and books on crystallography.

Laporte Build Plant for Hydrogen Peroxide

Preparations are being made at Laporte Chemicals' Baronet works, Warrington, Lancs, for the production of hydrogen peroxide by a process of autoxidation. New buildings are erected for the purpose and there will also be new plants for the production of sodium perborate and organic peroxides.

Gift from Dunlop

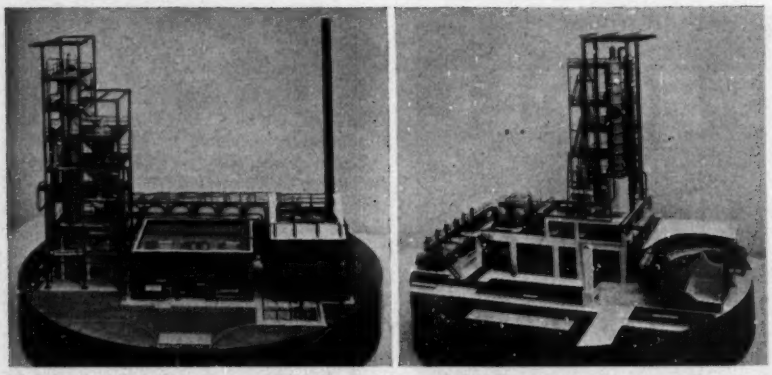
A donation of £1,000 has been made by the Dunlop Rubber Co. to the Production Engineering Research Association's fund for the development of a new workshop and laboratory.

Obituary

MR. ARNOLD WHITAKER, B.Sc., D.I.C., A.R.C.S., died on 9 November at the age of 64. Since 1946 he has been at the Building Research Station, Garston, as a senior experimental officer engaged on work on flue gases. He graduated in 1915 at the Royal College of Science, and until joining DSIR worked as a chemist for the Admiralty.

DR. FELIX SINGER died recently at his home in South Croydon. He was 69.

His reputation in the field of ceramics was international, and his work took him all over the world. He was a Fellow of the American Ceramic Society and the British Institute of Ceramics. He wrote many articles for the Press and published a number of books.



Models of two continuous tar acid distillation plants : left, Chemical Engineering Wiltons Ltd., and right, Woodhall-Duckham Construction Co., Ltd.

Exhibition Shows Tar Distillation Plant and Products

An exhibit designed to show the various processes, types of plant used and the range of products made by distillation of tar, has been provided by the Association of Tar Distillers and has been placed in the industrial chemistry section of the Science Museum, South Kensington.

The display consists of two show cases, one large and one small. The larger contains an illuminated flow diagram which explains the principles of continuous distillation of tar and the treatment of the resulting products, shows samples of these products, and by small models indicates subsequent uses in industry, in medicine, in dyes and in many other ways.

On each side of this diagram are models of continuous tar distillation plants made by Chemical Engineering Wiltons Ltd. and Woodall-Duckham Construction Co. Ltd. These two models are mounted on revolving bases which can be stopped at any point to examine details of construction.

The smaller case contains two models sectioned to show the construction and details. The first is of a tar acids distillation plant designed by the APV Co. This model was originally given to the museum by APV in October 1956 (see CHEMICAL AGE, 27 October 1956, p. 183) and is an exact reproduction of a distillation plant at Beckton, East London, gas works which has produced 4,450 tons of refined phenols in the past year.

The second model represents the latest type of plant used to produce high grade naphthalene in either liquid form for transport in heat insulated tank vehicles or as crystallised product in bags. The plant is designed by Proabd (England) Ltd.

Facing the coal tar exhibit is the benzole exhibit presented to the museum in July 1957 by the National Benzole and Allied Products Association. These two exhibits together were designed to give as complete a picture as possible of the by-products coal tar industry.

Both exhibits are adjacent to those of the petroleum industry and together these show the production of basic raw materials for the organic chemical industry.

ICI Plan Third Large Carbonylation Plant

Confident belief that ICI's new heavy organic chemical division would thrive in the competitive conditions of a European free trade area was expressed by Mr. T. B. Clark, commercial director designate of the new division. He was speaking at a conference held by the Billingham division to discuss overseas markets in general and the implications of the free trade area in particular. The conference was attended by representatives of the company's agents and subsidiary companies in Europe and the Far East.

Mr. Clark added that the practical effects lay some way ahead. Their immediate task was to create a new attitude of mind, 'we must now think of Europe as a whole, not the UK alone, as a home market.'

Welcoming the visitors, Mr. W. J. V. Ward, Billingham division chairman, told them that the export of organic chemicals by the division had risen steadily in recent years. Since 1954 the value of these exports had doubled and it was expected to double again during the next two years.

As evidence of the company's intention to develop its heavy organic chemicals business as rapidly as possible, Mr. Ward mentioned the starting up earlier this year of the second large-scale carbonylation plant on the Billingham site and the plan for a third unit of the same kind which, when it came into operation in mid-1959, would make the total carbonylation capacity roughly 60,000 tons a year.

Perhaps the most significant development of all, however, was the announcement during the conference of the formation by ICI of the new heavy organic chemicals division to come into operation on 1 January, 1958. This new organisation would take over from the Billingham division responsibility for the manufacture and sale of heavy organic chemicals both at Billingham and at Wilton.

Cost of US Rocket Propellants

According to H. W. Ritchey (*Chem. and Engng. News*, 1957, **35**, No. 45, 78), at the present rate of missile production, the guided missile field will soon reach $3 billion per year. It is not possible to state specifically what portion of this figure is used for production procurement. It is estimated, however, that the cost of propellant materials does not approach anywhere near 5 per cent of a finished missile. In fact, the figure in many instances is considered to be 0.5 per cent. A sum of $30 million is considered to represent a top annual figure for the value of rocket fuel materials going into missiles. Cost of research and development fuels would add to the figure.

It is suggested that the relatively low ratio of propellant dollar gross to total guided missile gross is likely to increase in the future. Ritchey points out that even relatively minor improvements in propellant specific impulse and in the propellant 'mass ratio' may permit a tenfold saving in missile weight for the accomplishment of a given mission. Therefore, a propellant costing 10 or 15 times that of present propellants would, in the long run, prove to be a more economical propellant for a given application. Thus 'by aggressive research and ingenious development, it should be possible for the chemical industry to increase its slice of the guided missile market.'

ICI Commission New Dehydration Unit

A new industrial nitrocellulose dehydration plant is now in operation at Imperial Chemical Industries' Ardeer works. This has resulted in the elimination of intermediate handling and transport stages. The process of dehydration and spirit-wetting follows continuously from the blending stage.

The slurry of nitrocellulose in water is pumped from the blending house to the dehydration plant and discharged into either of two large stainless-steel storage vessels. Previously the water damp material had to be transported about a quarter of a mile to the propulsive departments dehydration plant where it was prepared for dispatch to customers.

The dehydration process is carried out in centrifuges which are also used for the wetting with isopropanol. The whole process is carried out automatically. Isopropanol is used as the spirit-wetting substance because, it is stated, it is more easily dealt with by users in their subsequent processing.

Position of Widnes

Although Widnes no longer called the tune in the chemical industry, it employed 7,000 men and there were few places in the world where so many were employed in the same industry. Mr. J. Smith, joint managing director of general chemicals division, ICI, said this at the annual dinner of the Widnes Soroptimist Club. He thought that although the tide of chemical domination had receded from Widnes there were many more good things to come.

R. CRUICKSHANK LTD.

are pleased to announce
that owing to the installation of new and up to date
chemical plant, for the manufacture of

POTASSIUM FLUOBORATE
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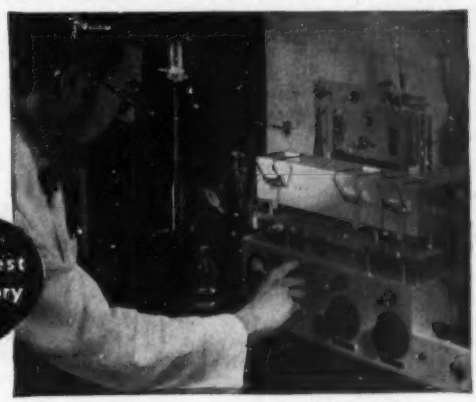
Incidental information
No. II

items of interest from our laboratory notebooks



2-(2-Pyridyl)-imidazoline—is of interest to the theorist by reason of its structural relationship to 1:10—phenanthroline, and is of use to the practical analyst because of the selective reaction it affords for iron. (*see* **Anal. Chem.**, 1954, **26**, 217.) It has lately been added to the Hopkin & Williams range under Code 7275.8.

6-Aminothymol hydrochloride has been proposed quite recently (**Analyst**, 1957, **82**, 61) as a reagent for the colorimetric determination of thiamine in pharmaceutical and cereal products. The reagent is now available from Hopkin & Williams Limited (Hopkin & Williams Code 1395).

***tri*-Sodium pentacyano-ammine ferroate** provides a means of determining isoquinoline (*see* **Analyst**, 1956, **81**, 718) in the presence of quinoline and quinaldine. But the reagent must be of suitable quality for such an application. Hopkin & Williams Code 7972 has been specially prepared and tested for this purpose.

H&W

HOPKIN & WILLIAMS LTD.
Manufacturers of pure chemicals for Research and Analysis
CHADWELL HEATH · ESSEX · ENGLAND

Commercial News

Fisons Seek £4m. New Capital for Expansion Programme

PERMISSION to raise about £4 million by an issue of ordinary shares is being sought from the Capital Issues Committee, Sir Clavering Fison, chairman of Fisons Ltd., has announced. This additional capital is required for financing part of the considerable programme of expansion which is to take place during the next few years.

Group sales at home and abroad, including those of subsidiary companies and the proportion of sales of associated companies attributable to Fisons' investments in them were £44,750,000 for the year ended 30 June last compared with £41,500,000 in the previous year. Group trading profit was £3,095,000 compared with £3,051,000 in 1955-56. Group net profits increased last year from £1,238,762 to £1,576,413. Total dividend recommended is 15 per cent (same).

The chairman remarked that shareholders might feel that there was a case for a moderate increase in dividend. He pointed out, however, that a considerable programme of expansion has been authorised over the next few years and new capital will be needed to finance part of the scheme although cash resources exceed £5 million.

Authorised group capital expenditure amounts to £6,035,000 (£6,930,000) with commitments under contracts for capital expenditure totalling £2,241,000 (£1,329,000). Net current assets are nearly £4 million higher at £12,297,229 (£8,315,169). Stocks are also heavier at £9,555,395 (£7,952,504). Details of the chairman's review appear on page 824.

A. B. Fleming (Holdings)

Oil and colour manufacturers, A. B. Fleming (Holdings) announce an unchanged interim dividend of five per cent for the year to 31 March 1958. Group sales and profits for the half year to 30 September are stated to be comparable with those of the corresponding period in the preceding year. In 1956-57, there was a nine per cent final dividend.

L. B. Holliday (Holdings)

Group profits of L. B. Holliday (Holdings) Ltd., aniline dye manufacturers, for the year ended 30 June were £115,010 (£79,556), after tax of £122,044 (£90,995). Final dividend on ordinary is 5¼ per cent (4 per cent), making 8¼ per cent (7 per cent).

Simon-Carves Ltd.

The directors of Simon-Carves Ltd. have declared an interim dividend of 7½ per cent (same) to be paid on 16 December. The total dividend paid for last year was 20 per cent.

Tube Investments

An unchanged final dividend of 7½ per cent has been announced by Tube Investments Ltd., making with the increased interim 15 per cent for the year ended 31 July 1957 as against 13¾ per cent.

Subsidiaries' trading profits rose by £1 million to £15,650,685. After heavier provisions for depreciation and tax, group net profit (after outside interests), has risen from £5,271,209 to £5,510,909.

During the first quarter of the current year, it is announced that there have been indications of a slackening in demand. Outlook is described as uncertain and if the present trend continues it may involve some curtailment of operations.

Metal Products Co.

Metal Products Co. (Willenhall) are reducing the interim dividend from 10 per cent to 7½ per cent 'due to restriction of profits caused by the continuous fall in the value of non-ferrous metals', state the directors.

Willows Francis Ltd.

Home and overseas sales of the specialised pharmaceutical preparations made by Willows Francis showed a further increase in the year ended 30 June last. Although higher cost absorbed a substantial proportion of the bigger profit, trading surplus rose from £86,000 to £96,000. Plant and property additions during the past year have been comfortably met from internal resources and finances are declared sound.

Profit declared for the year to 30 June last is £74,066 (£68,724) before tax of £39,984 (£36,833). Reserves and surplus are £103,699 (£80,151). The dividend has been maintained at 17½ per cent.

NEW COMPANIES

AGRYL (LEEDS) LTD. Cap. £1,000. Commission agents, wholesale and retail merchants, importers, exporters and manufacturers of and dealers in artificial and organic manures, fertilisers, insecticides, and fungicides, etc. Directors: J. . B. Blomfield, N. M. Jordan and A. H. Gordon. Reg. office: 17 Station Road, Mirfield.

PALMER HYGIENE SERVICES LTD. Reg. November 7. Cap. £100. Advisers, consultants and specialists in hygiene, pest control and fumigation, etc. Subscribers G. Winter, K. Dickson. Reg Office: 27 Albemarle Street, London W1.

W. H. S. MACDONALD LTD. Cap. £7,200. Manufacturers of and dealers in animal charcoal, sulphate of ammonia, bone oil, etc. Directors: R. J. B. Macdonald, A. V. Macdonald, J. G. Kerr. Reg. office: 21 Dellingburn Street, Greenock.

INCREASES OF CAPITAL

A V S MANUFACTURING COMPANY (PRESTON) LTD. Manufacturing chemists, etc. Windsor Works, Leighton Street, Preston. Increased by £15,000 beyond the registered capital of £5,000.

SHEPHERD HILL AND CO. LTD., mineral, metal, ore and chemical merchants, etc., 25/7 Central Chambers, Ealing Broadway, London W5. Increased by £90,000, in £1 ordinary shares, beyond the registered capital of £10,000.

LONDON GAZETTE

Appointment of Liquidator

THE PHARMACO-CHEMICAL PRODUCTS CO. LTD., manufacturers of fine chemicals, Walsingham House, Seething Lane, London EC3. Stanley Water Charles Sprunt, Thames House, Queen Street Place, London EC4, has been appointed liquidator by the members.

Market Reports

NO SLACKENING IN EXPORT INTEREST

LONDON The industrial chemicals market during the past week has been without feature and home demand is probably on a broader basis although new business for the most part is restricted to meeting nearby requirements. The intake against contracts is reported to be well up to schedule while the flow of overseas enquiry shows no sign of diminishing.

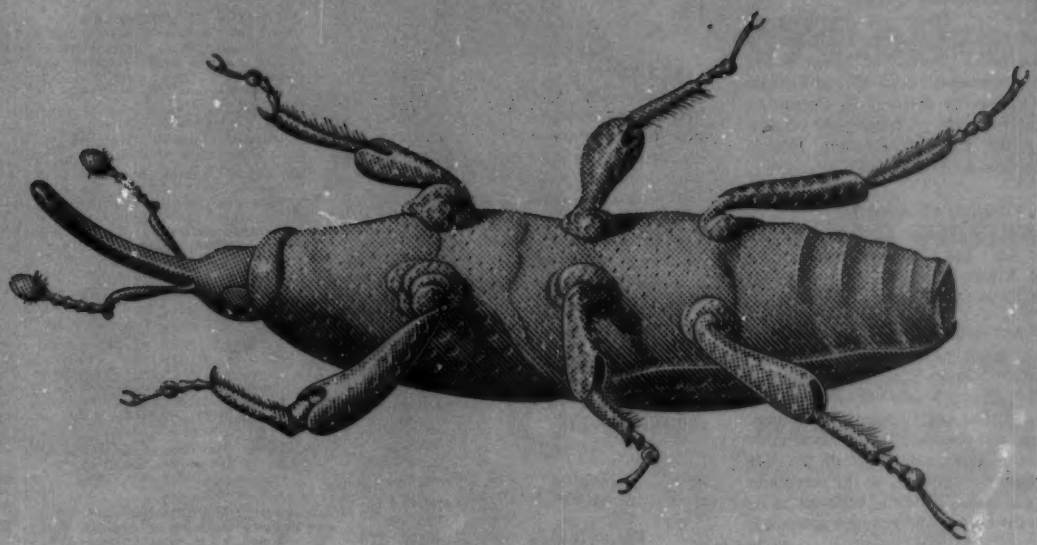
The price position generally remains steady, but the non-ferrous metal compounds are subject to fluctuations with changes in metal prices which appear to have a firmer trend. The basis price for dry white lead is up by £2 per ton and red lead is £2 15s per ton dearer as from 8 November. The new price for litharge is £2 15s per ton higher at £125 15s.

There is little of fresh interest to report from the fertilisers market and buying interest in the coal tar products market is fairly well maintained with pitch finding a good outlet on home and export account.

MANCHESTER Although fresh enquiry and actual new business have been somewhat less in evidence on the Manchester chemical market during the past week the pressure for supplies of the alkalis and most other leading heavy chemicals against contracts has been maintained on a reasonably good level on home-trade account, while the shipping movement continues to be satisfactory. Prices throughout are on a firm basis. Basic slag and the compounds are active sections of the fertiliser trade and good quantities of sulphate of ammonia and other materials are being absorbed by mixers. A steady movement of the tar products is reported.

GLASGOW A busy week's trading has been experienced in the Scottish heavy chemical market. Demands were varied, and quantities well maintained. Orders placed were mostly against contract and spot requirements, with the usual range of chemicals involved. Prices remained firm showing little or no change. The usual flow of export enquiries was received and the market showed indications that the steady demand would continue.

Deadly to insects



Harmless to foodstuffs

Pyrethrum-based insecticides

Pyrethrum P.Y.R. is harmless to animals and human beings. It can be used safely in close proximity to foodstuffs.

Pyrethrum P.Y.R. combines very high knock-down with effective killing power. And with suitable synergists these effects can be markedly enhanced.

Insecticides based on African Pyrethrum are particularly effective in dealing with flying insects and with pests that attack stored products. They do a first-class job in public health work and in the protection of food supplies.

Insects do not develop resistance to Pyrethrum P.Y.R. as they do to many other insecticides.

Detailed information about African Pyrethrum and advice on its use for domestic, industrial and other purposes are available on request.

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The Pyrethrum Board of Tanganyika, Mbeya, Tanganyika Territory
Société Co-opérative des Produits Agricoles, Goma, Belgian Congo

TRADE NOTES

West Instrument Ltd., 52 Regent Street, Brighton, have opened a Midland sales office at 43 Factory Centre, Lifford Lane, Kings Norton, Birmingham 30, telephone Kings Norton 4412. Mr. C. G. Wolstenholme will be in charge. (See p. 817).

Beryllium Copper

The Board of Trade are disposing of 37 tons of beryllium copper master alloy with a beryllium content of about 4 per cent. The material is being offered for sale by open tender for delivery in December and January. Forms of tender are obtainable from the BoT, G7, Lacon House, Theobalds Road, London WC1.

Change of Address

Richardson Scale Co. Ltd., and Ensign Conveyor Co. Ltd., have changed their address to Albert Street, Bulwell, Nottingham (telephone Nottingham 27–1530).

Power-Gas Plant Orders

Chemical plant by the Power-Gas Corporation, Stockton-on-Tees, is to be shipped to Modderfontein, South Africa, for the African Explosives and Chemical Industries, Ltd. They are also acting as main contractors for a substantial part of the ICI Ltd. Billingham extensions to the ammonia synthesis gas plant, which is believed to be the first in the country to produce ammonia from oil.

Free-Piston Contract for Australia

National Free Piston Power Ltd., newly formed company of the Brush Group, are to receive a contract from the Zinc Corporation Ltd. for the supply of a free-piston turbo-air compressor plant for installation at Broken Hill, Australia. The plant will consist of three National GS.34 free-piston gasifiers, one Brush (series 200) expansion gas turbine, direct coupled to an Oerlikon rotary air compressor.

ICI's New Blue Dyestuff

Carbolan Brilliant Blue 2G is the latest Imperial Chemical Industries' dyestuff. The new dye gives very bright greenish blue shades and is for use in dyeing wool. It is applied to the wool in a dyebath containing neutral or only slightly acid solutions.

It is claimed that the dye has a high fastness to both light and moisture, combined with 'a vividness of shade unobtainable with any other existing wool dyestuff'.

Applications also include dyeing of rabbit or hare fur for mélange hats as well as for dyeing of shoddy. It can also be used to dye nylon and silk and for the direct printing of wool, weighted and unweighted silk.

Esperanza Copper

At a meeting of Esperanza Copper and Sulphur held recently, the chairman, Mr. J. Ivan Spens, stated that it had been decided to operate on a major scale in water leaching the Limni semi-oxidised ore-body from which it was estimated that about 7,000 tons of cement copper averaging 65 per cent metal would be recovered together with gold and silver. Plant and equipment was available with the exception of a special pump unit which was due to be delivered at the end of December when operations could then be started.

Changes of Name

GEL CHEMICALS LTD., 11 Ironmonger Lane, London EC2. Name changed to Gel Holdings Ltd.

E. SPIERO CHEMICALS LTD., 55 Belmont Road, Wallington, Surrey, have changed their name to Metal Pretreatments Ltd.

Tred Now in Bulk Supply

Tred 50 and Tred 85, the styrene butadiene resins of Monsanto Chemicals Ltd. are now available in commercial quantities from a modern plant at the company's Newport works. Previously made on a pilot plant scale, their main application is resin rubber, semi-expanded and microcellular soling.

Damages for Sulphur Accident

At Chester Assizes, on 4 November, Joseph Gill, of Overpool, Ellesmere Port, was awarded £300 agreed damages with costs against Shell Refining and Marketing Company Ltd. Mr. Gill was employed as a fireman operator in the sulphur recovery unit at Thornton Refinery, Stanlow. On 18 July 1954 he was walking across solidified sulphur when he tripped, penetrated the crust and sustained severe burns to the left arm and both legs. The burns resulted in scarring and disfigurement.

PUBLICATIONS RECEIVED

Movement in Industry: The Rolaveyor (302) and the Collis Truck (303). J. Collis and Sons Ltd., Regent Square, Gray's Inn Road, London WC1.

Aero Research Technical Notes: Use of Aerodux 185 resorcinalformaldehyde glue. Aero Research Ltd., Duxford, Cambridge.

Zerox for the deoxygenation of boiler feed water: Whiffen and Sons Ltd., Fison House, 95 Wigmore Street, London W1.

Lead News: Uses of lead to increase sensitivity of detecting and measuring devices in nuclear energy field. Lead Development Association, 18 Adam Street, London WC2.

Desizing with Termozym and Aquazym: Use of enzymes for desizing. Novo Industri A/S, Copenhagen, Denmark (Globe Products (Accrington) Ltd., District Bank Chambers, St. James Street, Accrington, Lancs).

Climbing Film Evaporator: QVF Ltd., Duke Street, Fenton, Stoke-on-Trent, Staffs.

Epok Resin Emulsion V.750: Information sheet No. E103/1. British Resin Products Ltd., Devonshire House, Piccadilly, London W1.

Timbers for Flooring: Bulletin No. 40, Forests Products Research, Department of Scientific and Industrial Research. HM Stationery Office, price 2s 6d.

Hard Moulding Compositions from Natural Rubber: Broadsheet No. 6, The Natural Rubber Development Board, Market Buildings, Mark Lane, London EC3.

FOR YOUR DIARY

MONDAY, 18 NOVEMBER

Bradford Chemical Society and SCI—Bradford; Technical College, Great Horton Road. 7 p.m. 'The action of sulphuric acid on wool' by Dr. R. S. Asquith, D. Dawson and R. L. Elliott and 'Town gas production in Western Europe' by P. C. Finlayson.

Institute of Packaging—Birmingham; Imperial Hotel 2. 6.45 p.m. A study of the packaging of industrial chemicals. 'The manufacturers viewpoint' by a leading chemical manufacturer.

Society of Chemical Industry—London; 14 Belgrave Square, SW1. 5.30 p.m. Newer developments in pesticides; (a) 'Maleic hydrazide—plant growth depressant' by F. Chapman (b) 'Amiton—a new acaricide and scalicide' by G. L. Baldit and (c) 'The mite ovicidal activities of some unsymmetrical bis-phenoxymethanes' by Dr. M. B. Green and W. Jenkins.

Society of Chemical Industry—London; The Royal Empire Society, 18 Northumberland Avenue, WC2. 6.30 p.m. Programme of scientific films.

TUESDAY, 19 NOVEMBER

Institution of Chemical Engineers—Manchester; Reynolds Hall, College of Science and Technology. 7 p.m. 'Problems in the design of pressure vessels for the Calder Hall type of nuclear reactor' by R. W. Lakin and 'Non-ferrous pressure vessels' by H. T. Bone.

Plastics Institute—London; Wellcome Buildings, Euston Road, NW1. 6.30 p.m. 'The flow properties of polythene and their effect on fabrication' by P. L. Clegg.

WEDNESDAY, 20 NOVEMBER

Plastics Institute—Newcastle; Eldon Grill, Grey Street. 7 p.m. 'Developments in butadiene copolymers' by N. D. Macleod.

Royal Institute of Chemistry—London; The Royal Society of Health, 90 Buckingham Palace Road, SW1. 6 p.m. Annual general meeting of London Section.

Society of Analytical Chemistry—Edinburgh; Department of Chemistry, University, West Mains Road. 4.30 p.m. 'A new line in the development of metal indicators' by Dr. Rudolf Pribil.

Society of Chemical Industry—Dublin; Chemistry Department, University College. 7.45 p.m. 'Radioisotopes and radiation energy in industry' by H. Seligman.

Society of Chemical Industry—London; 14 Belgrave Square, SW1. 6.30 p.m. 'Protection of magnesium alloys' by W. F. Higgins.

THURSDAY, 21 NOVEMBER

Chemical Society—London; Burlington House, Piccadilly, W1. 7.30 p.m. 'The chemistry of bacteria. Part VII. The structure of violacein' by J. A. Ballantine, C. B. Barrett, R. J. S. Beer, Stephen Eardley, Alexander Robertson, B. L. Shaw and T. H. Simpson, 'The structure of laminarin. Part I. The main polymeric linkage. Part II. The minor structural features' by Stanley Peat, W. J. Whelan and H. G. Lawley, 'Indicator measurements in the system acetic acid—zinc chloride—hydrogen chloride' by D. Bethell, V. Gold and D. P. N. Satchell, and 'Aromatic alkylation. Part II. Zinc chloride catalysis of diarylmethylation reactions in acetic acid' by D. Bethell and V. Gold.

Royal Society—London; Burlington House, Piccadilly, W1. 4.30 p.m. Special general meeting to consider the annual report of council, followed by 'Haemolysis and haemolytic acceleration' by Sir Eric Rideal and F. H. Taylor and 'Osmotic equilibria in human erythrocytes studied by immersion refractometry' by D. A. T. Dick and Leah M. Lowenstein.

Society of Chemical Industry—Preston; Harris Institute. 7.30 p.m. 'Polyurethanes' by L. N. Phillips.

Society of Chemical Industry—London; 14 Belgrave Square, SW1. 6 p.m. 'Producer-gas fired lime kilns' by B. J. Gee.

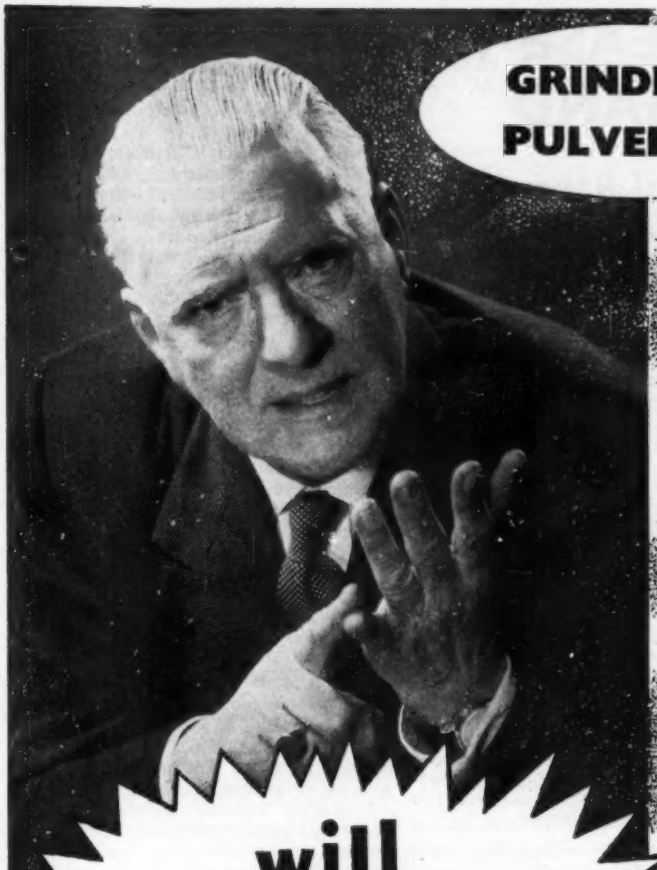
FRIDAY, 22 NOVEMBER

CS, RIC and SCI—Aberdeen; Physiology lecture room, Marischal College. 7.30 p.m. 'High conversion polymerisation' by Prof. G. M. Burnett.

RIC and SCI—Cardiff; University College. 7 p.m. 'The preparation and reactions of nylons' by A. R. Munden.

SATURDAY, 23 NOVEMBER

SAC and Association of Public Analysts—Bristol; College of Technology, Muller Road. 2 p.m. 'Radioactivity and its measurement in foods and water'.



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CONTINUED INCREASE IN FERTILISER DEMAND

Sir Clavering Fison's Annual Report

CONSUMPTION of fertilisers in the UK in 1956-57 again increased. Nitrogen and potash showed increases although these were smaller than in the previous year. This was stated by Sir Clavering Fison, chairman of Fisons Ltd., in his review of the financial year 1956–57. Phosphates consumption remained almost the same. The result of these changes in individual plant foods has been a further increase in the total plant nutrients consumed. Nevertheless, the rate of increase represents a slowing down. In explanation, mention is made of the great difficulties encountered last spring in obtaining satisfactory seedbeds.

UK Fertiliser Consumption 1956–57

	Nitrogen in tons N	Phosphates in tons P_2O_5	Potash in tons K_2O	Total plant nutrients
1956–57	302,000	385,000	317,700	1,004,700
1955–56	291,300	385,900	305,500	982,700

Compound fertiliser consumption in terms of plant food nutrients has again risen considerably, Sir Clavering notes, and largely accounts for the increase in potash consumption. Most of the potash used is applied as a constituent of compound fertilisers and in response to farmer demand there has been a tendency to increase the proportion of this element. The rather more modest increase in nitrogen is also a reflection of increased use in compounds as well as heavier applications of straight fertilisers. This wider use is deemed to be due to increased sowings of the new varieties of cereal which respond well to heavier applications of nitrogen.

Phosphate Levelling-off

The levelling off in phosphate consumption gives rise to concern, Fisons' chairman says, particularly when it is associated with increases in the other two elements, because of risk of unbalanced use of the three plant foods. It is emphasised that soil analysis is not always a reliable guide to the response obtainable from phosphate fertilisers. At Fisons' Levington Research Station intensive research is at present being carried out on this question.

It is noted that Fisons sold over 300,000 tons of high grade basic slag, an inexpensive source of phosphate.

Nitrogen demand in this country is stated by the chairman to have been substantially in agreement with their forecasts, and their decision to provide through a long-term contract with the Shell Company for a substantial part of their supplies, still appeared 'entirely justified'. Their new project would also satisfy Fisons' requirements, it is claimed, for nitrogen in a form more concentrated than sulphate of ammonia, which they have used previously. They believe the project will prove to be 'fully economic'. They will still require to purchase, however, large quantities of sulphate of ammonia and possibly other forms of nitrogen. It is the company's policy, while increasing their own production of nitrogen, to purchase substantial quantities on the open market as long as those continue to be freely available.

The prospect of a European free trade area, to which Fisons have given their support through the Federation of British Industries, will oblige them, and other manufacturers, it is stated, to review the nitrogen situation. The report stresses that Italy and France, in particular, have substantial quantities of natural gas at their disposal, which is, in general, a very cheap raw material for the manufacture of ammonia and this, together with the larger installations, is the reason for the lower level of costs in these countries and also the US. The chairman suggests that it may be possible for Fisons to make arrangements for ammonia manufacture in Europe, and to transport the material here. These matters are the subject of studies Fisons are now making.

Position in Morocco

Because of the unstable political situation in Morocco, and the possibility of interrupted phosphate rock supplies, reasonable precautions have been taken. Thus Fisons have increased their holding of phosphate rock by the purchase of certain supplies from the US. These measures have proved very costly and are not fully reflected in the company's revised index of raw materials costs. Taking 1953–54 as 100, the index figure last year was 132.1 and compares with 126.3 in 1955–56. This is a much smaller change than the company have had in the last four years, 1954–55 being 110.6. The index is stated to mask some rather violent changes and does not reflect the circumstances surrounding their chief material, phosphate rock. Also sulphate of ammonia price this year has shown only a very small increase. For the first time this material was in free supply on the world market and British manufacturers, who have previously sold abroad at prices higher than those charged in this country, were unable to obtain a premium.

Freights are also 'a major element', although the company was insulated against the effects of freight increases due to Suez last autumn by their forward chartering. Freights are now stated as being at the lowest level for many years. As a result, the company's costs are likely to remain fairly stable while any reductions in freight should offset other increases which have occurred. The decline in sulphur price is mentioned in particular. Hope is expressed that the Moroccan authorities will substantially reduce the price of phosphate rock as the present prices are stated to be quite uncompetitive with those of the US.

Despite the cost of materials and the cost of the company's phosphate rock policy no increases in price during the year were made. A small increase has recently been made in Fisons' fertiliser prices to offset home freight costs.

All the company's fertiliser factories worked at full pressure throughout the year. Early this year the new compound granulation unit at Plymouth was successfully commissioned. Besides augmenting capacity, this plant enables the company to offer product service to farmers in Devon and Cornwall.

There is good reason, Fisons consider, to expect further increases in fertiliser consumption as Government advice and their own service to farmers bears fruit.

Speaking of Fisons Pest Control Ltd., the chairman said that the year under review was unsatisfactory for the weedkiller business. On the other hand, however, the insecticide business was good. Reduction in the price of MCPA had been made possible by the completion and commissioning of the company's new plant at Felixstowe which is believed to be the largest in Europe. After three years of serious difficulties the plant has now reached a high level of efficiency.

Overseas

The overseas picture was varied. Fisons' Indian company, in which they are associated with Tata Chemicals Ltd., has made excellent progress. This company has also acquired Geigy Insecticides Ltd.

Regarding overseas associated companies, in Canada, International Fertilisers Ltd. had another difficult year but earned a small profit. Prospects for the coming season are described as more favourable. Fertiliser consumption in South Africa suffered a setback last year. Good progress is being made by Fisons (Pty) Ltd., with the erection of their new fertiliser factory at Sasolburg in the Orange Free State. In Rhodesia prospects of Fisons (Rhodesia) Ltd. are described as bright and a further increase in fertiliser consumption is expected as a result of record realisations for the tobacco crop.

At home the associated company, Murgatroyd's Salt and Chemical Co., have had a very successful year, and the benefits of the increased output have fulfilled expectations.

Another associate, the United Sulphuric Acid Corporation, achieved more than the designed production during the year under review with resulting lower costs.

Considerably better results have been noted, due to the continuous programme of reorganisation and improvements, in Fisons' general chemical and pharmaceutical group. Total research appropriation by the companies involved is now considerable.

Sales of Whiffen's industrial chemicals increased by 20 per cent in the home market, whilst exports rose by 25 per cent and accounted for 55 per cent of output. Europe and the US provided the largest outlets. Sales for the first three months of the current year are reported as showing 'further satisfactory increases'.

Reference was made to Whiffen's successful hydrazine conference in May this year. Hydrazine is being used increasingly throughout the world as an oxygen-

scavenger in boiler-houses. In order to meet the increasing demand a new and larger plant embodying improved production features is in the last stages of construction and should be in production early next year. Production of the new type of expanded p.v.c., developed in Whiffen's research laboratories and known as Fi-Vi, has increased during the year. It is now under test in a wide range of countries.

In pharmaceutical chemicals, Whiffens increased their turnover by 10 per cent. Severe competition is again reported, however, from European manufacturers. Whiffen's exports in this field account for 60 per cent of sales. In India, the subsidiary company has commenced operations and emetine is being manufactured. Considerable opportunities for expansion are expected because of India's policy of encouragement of indigenous production of drugs.

Sales of ethical pharmaceuticals of Benger Laboratories have risen steadily, the chairman reports. Good results are claimed for Imferron (intramuscular/intravenous iron) which has been introduced this year in France, Germany and Austria. Demand in almost every other country is stated to be increasing rapidly. Genatosan has also had a successful year.

Fisons Chemical (Exports) Ltd. has increased its sales by more than 14 per cent, although this does not represent the true extent of development in overseas markets, for in some instances, it has been necessary to undertake manufacture, formulation or part manufacture in countries which encourage national industries.

On the subject of the European free trade area, Sir Clavering says 'our industry, with certain minor qualifications, lent its support to the proposals, although these were only presented to us in outline. We feel that any policy leading to the economic integration of Europe cannot fail to be to the ultimate advantage of everyone. The transition from a national to an international economy will not, of course, be easy, but we, as as individual business, feel that we have the organisation and ability to deal with the problems of the transition as efficiently as any other business. From studies we have made we have reason to think that we are on the same level of efficiency as the best European companies in our industry and we do not fear the future. We intend, subject to adequate safeguards for agriculture, to give our strongest support to the proposed free trade area.'

Regarding the company's new research laboratories at Levington, the station is reported as now fully operational so far as the department of soil science is concerned. The department of chemistry is not fully staffed as yet. Increasing emphasis is being placed on chemical and engineering technology needed for making the types of fertiliser likely to be in demand in the coming decade. Expenditure on research throughout the group, already at a high level, continues to expand. Support is being given by the company, too, to research in universities by sponsoring research fellowships and studentships.

As many managerial decisions nowadays turn upon a correct appraisal of technological possibilities and arguments it is the management's policy to have leading technologists on its board.

Chemical Pioneers — 13

(*Continued from page* 816)

At Carville Works, Glover and his partners continued to manufacture sulphuric acid, Leblanc soda and bleaching powder until 1882. In that year the competition of the Solvay ammonia-soda process, so successfully introduced into this country by Brunner and Mond in 1873, very seriously affected the Tyneside alkali trade. Carville Works and others had to shut down; Glover's active connection with chemical industry ceased.

His earlier years of retirement were occupied with various local philanthropic interests, but with advancing age he became totally deaf. John Glover died at his home in Newcastle on 1 May 1902. With more worldly prudence he could have reaped the material reward of contributing 'beyond the ordinary to the well-being and prosperity of his fellows', but, as he told his children, he considered that 'effort is always nobler than success'.

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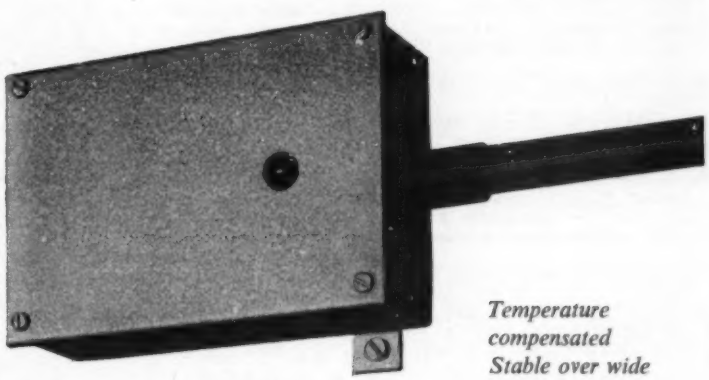

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Specifications filed in connection with the acceptances in the following list will be open to public inspection on the dates shown. Opposition to the grant of a patent on any of the applications listed may be lodged by filing patents form 12 at any time within the prescribed period

AMENDED SPECIFICATIONS

Will be on sale 18 December

Hydroperoxides. Du Pont de Nemours & Co., E. I. **700 546**

Alkaloid and its salts. Ciba Ltd. **734 108**

Silicon-containing lubricating compounds. Esso Research & Engineering Co. **762 601**

ACCEPTANCES

Open to public inspection on 16 December

Thermoplastic compositions. United States Rubber Co. **787 873**

Stabilisation of chlorine-containing polymers and polychloro compounds. Koninklijke Industrieele Maatschappij Voorheen Noury & Van Der Lande N.V. **787 930**

Immersion apparatus. Magnus Chemical Co. Ltd. (Magnus Chemical Co., Inc.). **787 774**

Rubber processing. United States Rubber Co. **787 931**

Microspheroidal siliceous catalysts and method of producing same. American Cyanamid Co. **787 934**

Producing hafnium-free crystal-bar zirconium from a crude source of zirconium. Commonwealth Scientific & Industrial Research Organisation. **787 778**

Ceramics. Norton Grinding Wheel Co. Ltd. **787 875**

Providing a semi-conductive body of cadmium-telluride with a tellurium layer. Philips Electrical Industries Ltd. **787 935**

Manufacture of chlorinated aliphatic hydrocarbons from cyclic organic compounds. Columbia-Southern Chemical Corp. **787 936**

Phthalic acids by oxidation of dialkyl benzenes. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **787 937**

Dyeing wth sulphur dyestuffs. Cassella Farbwerke Mainkur AG. **787 878**

Removal of iron impurities from aqueous solutions of sodium carbonate and bicarbonate. Diamond Alkali Co. **788 027 787 938**

Polyoxyethylene ethers for use in hydraulic fluids. Atlas Powder Co. **787 970**

Desdimethylaminotetracyclines and pharmaceutical preparations containing same. Lepetit Soc. Per Azioni. **787 882**

Silica-containing antistatic compositions. Mitsubishi Rayon Co. Ltd. **787 941**

Purification of vinyl chloride. Knapsack-Griesheim AG. **787 883**

Tetracycline. Lepetit Soc. Per Azioni. **787 791**

Thermally controlled coolant supply for metal-cutting tools. Gulf Research & Development Co. **788 032**

Pyridoxal derivative and the preparation thereof. Sterling Drug, Inc. **787 887**

Nitrogen dioxide compounds of 1, 3-dichloro-2-butene, and compositions containing same. Du Pont de Nemours & Co., E. I. **787 946**

Producing valuable gaseous hydrocarbons. Koppers Ges., H. **787 829**

Preparation of durene. Standard Oil Co. **787 888**

Acetylation process. Hoffmann-La Roche & Co. AG. **787 947**

Production of cyclohexene fluorocarbons. Minnesota Mining & Manufacturing Co. **787 919**

Dyeing textile material consisting of polyacrylonitrile and its copolymers. Badische Anilin- & Soda-Fabrik AG. **787 891**

Preparation of surface-active sulphuric acid alkyl ester salts and alkyl aryl sulphonates. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **787 950**

Trisiloxane. Midland Silicones Ltd. **787 800**

Manufacture and use of condensation products containing nitrogen. Ciba Ltd. [Divided out of 787 733.] **787 735**

Open to public inspection on 23 December

Liquid flow transport systems for solids, such as coal. Coal Industry (Patents) Ltd. **788 097**

Solid siliceous materials of high surface area, methods of making same, and composition containing them. Du Pont de Nemours & Co., E. I. **788 151**

Purifying ketene. Farbwerke Hoechst AG. **788 098**

Process and apparatus for the preparation of soot from acetylene or mixtures of acetylene and hydrocarbons. Knapsack-Griesheim AG. **788 154**

Production of explosives. Dynamit-AG, Vorm. A. Nobel & Co. **788 311**

Manufacture of polyethylene-glycol esters of substituted *p*-aminobenzoic acids. Evans, A. J. S. (Ciba Ltd.). **788 100**

Metal complexes of pyrazolone monoazo-dyestuffs and process for making them. Ciba Ltd. [Addition to 741 602.] **788 157**

Polyurethene resin moulding materials. National Research Development Corp. **788 062**

Devices for indicating or controlling the flow of solid powder or granular material. Londex Ltd., and Stern, H. G. **788 313**

Aqueous paint emulsions. Lechler, P., and Lechler, K. [trading as Lechler, P. [Firm of]]. **788 160**

Apparatus for contacting gases with finely divided solids. Esso Research & Engineering Co. **788 293**

Synthetic resinous coating compositions. General Electric Co. **788 163**

Electrodeposition of titanium, zirconium, hafnium, tantalum, vanadium, niobium, chromium, molybdenum and tungsten. Horizons Titanium Corp. **788 295**

Electrodeposition of titanium, zirconium, hafnium, vanadium, tantalum and niobium. Horizons Titanium Corp. **788 296**

Moulding reinforced plastic tubes. Distillers Co. Ltd. **788 063**

Process for separating and purifying condensation products. Perfogit Soc. per Azioni. **788 297**

Manufacture of cellulose triacetate filamentary materials. British Celanese Ltd. **788 315**

Polymeric polyethylene glycol esters. General Electric Co. **788 066**

Apparatus for dispensing liquids by gaseous pressure. Ward, L. T. **788 108**

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Stereoisomers of α-phenyl-α-piperidyl-(2)-acetic acid and process of making same. Ciba Ltd. **788 226**

Veterinary compositions. Canterbury Agricultural College. **788 227**

Diarylmethane derivatives. Imperial Chemical Industries Ltd. **788 168**

Method for transporting and storing natural gas and rendering it available for use. Constock Liquid Methane Corp. **788 173**

Preparing polyglycol terephthalate isophthalate copolyesters. Goodyear Tire & Rubber Co. **788 109**

Manufacture of titanium. Imperial Chemical Industries Ltd. **788 174**

Graft copolymers. Distillers Co. Ltd., and Norrish, R. G. W. **788 175**

Manufacture of 6, 10-dimethyl-undecanone-(2). Hoffmann-La Roche & Co., Akt.-Ges., F. **788 301**

Manufacture of geranyl-acetone and dihydrogeranyl-acetone and of hexahydropseudoionone therefrom. Hoffmann-La Roche & Co., AG. **788 302**

Resinous reaction products. Westinghouse Electric International Co. **788 230**

Removal of oxygen from water and solutions. Central Electricity Authority, Potter, E. C., and Whitehead, G. **788 112**

Thermo-electric pyrometer. Dunlop Rubber Co. Ltd. **788 179**

Soluble oil composition. Esso Research & Engineering Co. **788 322**

Production of tetraethyl lead. Ethyl Corp. **788 181**

Separation of materials of different specific gravities. Coal Industry (Patents) Ltd. **788 182**

Crystallisers. North Thames Gas Board. **788 183**

Preparation of steroid compounds. Glaxo Laboratories Ltd. [Divided out of 788 307.] **788 306 788 307**

Silicon-containing resinous products and compositions containing same. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **788 074**

Fractionating trays. Monsanto Chemicals Ltd. **788 075**

Polymeric organo-tin compounds. Montecatini Soc. Generale per L'Industria Mineraria e Chimica. **788 325**

Production of mutants of the genus penicillium. Glaxo Laboratories Ltd. **788 118**

Preparing high melting point greases. California Research Corp. **788 238**

Beryllium alloys. United Kingdom Atomic Energy Authority. **788 239**

Cooling apparatus for liquids. Whitehouse & Sons Ltd., J., and Whitehouse, R. J. **788 240**

Filtration. Imperial Chemical Industries Ltd. **788 119**

Process for preventing the electrostatic charging of synthetic fibres. Imperial Chemical Industries Ltd., Baird, W., Batty, J. W., Henshall, A. E., and Jones, G. T. **788 079**

Production of zirconium tetrachloride. United Kingdom Atomic Energy Authority. **788 327**

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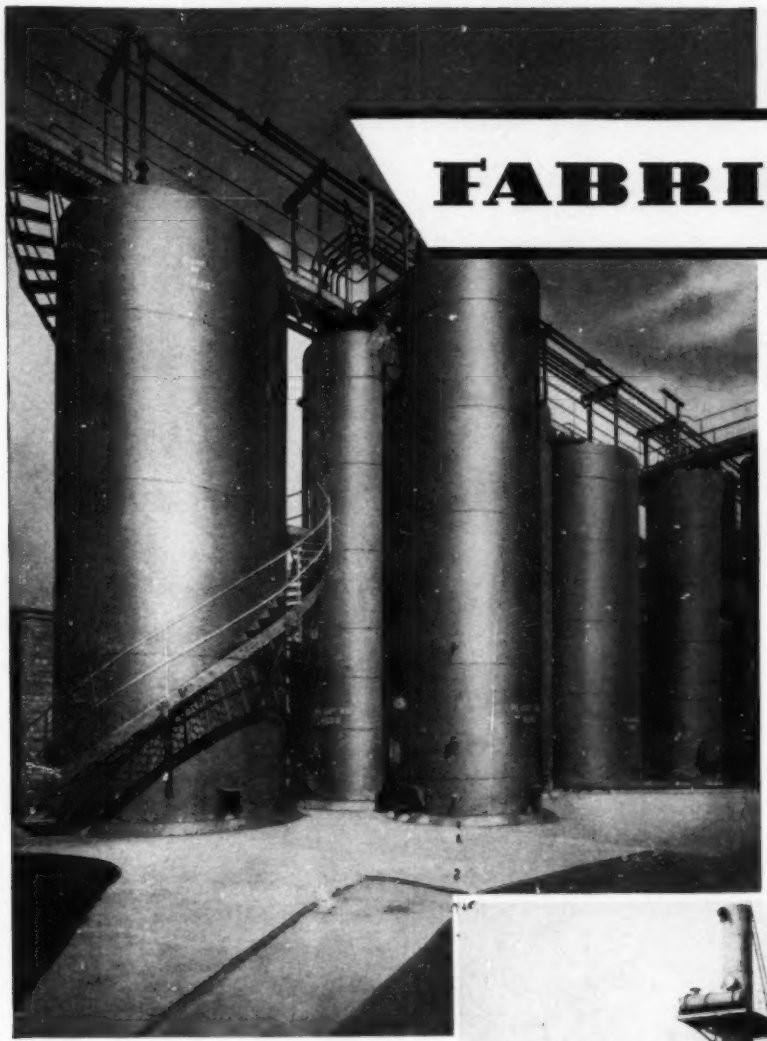

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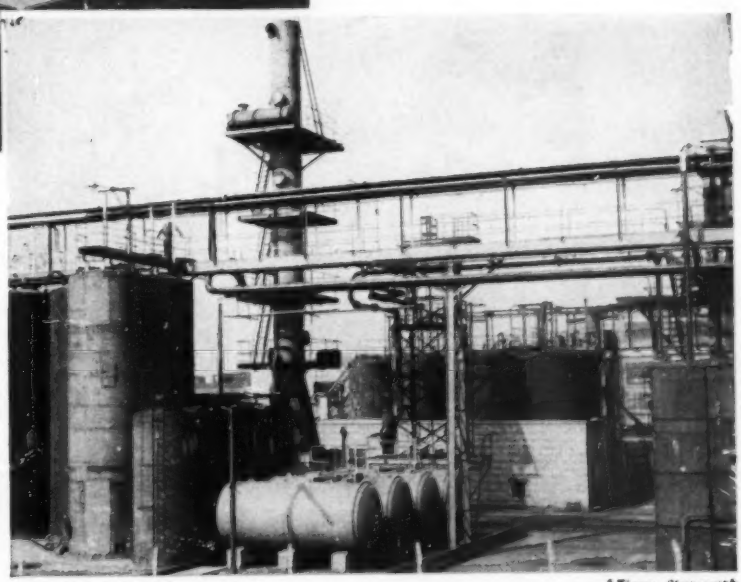

(above) Part of a battery of twelve mild steel storage tanks —the largest (of which there are four) being 12 ft. in diameter and 30 ft. high.

(right) Mild steel fractionating column, complete with condenser and battery in storage tanks; part of the plant supplied to Ashburton Chemical Works Ltd., a member of the Geigy Group of Companies.

Times Photograph

WFE

WIDNES FOUNDRY & ENGINEERING Co LTD

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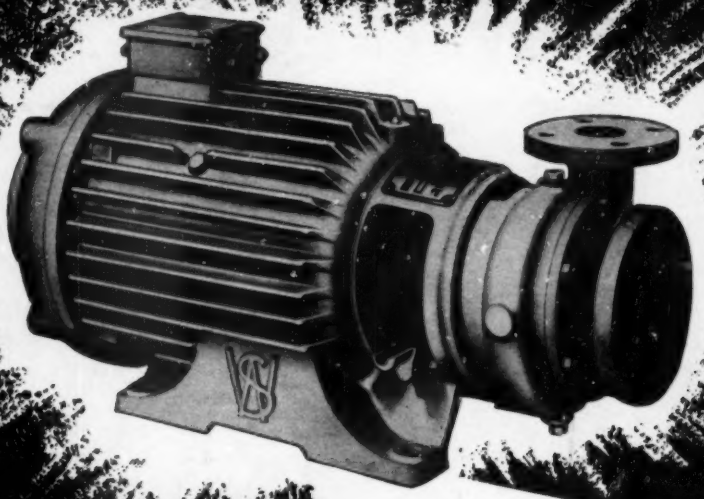

put it to the test!

These new pumps open up an extensive range of acids, alkalis and slurries to economical pumping. They are constructed in 18/8/3 Stainless Steel for mildly corrosive liquids or in WORTHITE, a super-resistance alloy steel enabling Sulphuric Acid to be pumped with negligible corrosion loss. Also there is the added advantage of easy interchangeability of the Stuffing Box Packing with two types of Mechanical Seal to suit different processes — plus the embodiment of the well known Worthington-Simpson "Monobloc" construction which means few parts, lower costs, less wear and easier installation.

MONOBLOC CONSTRUCTION
with all affected parts in
18/8/3
STAINLESS STEEL
for mildly corrosive liquids or where contamination and discolouration of the liquid must be avoided

WRITE FOR SPECIMEN 1¼" DISCS AND TEST THESE MATERIALS UNDER YOUR OWN SITE CONDITIONS

ALSO AVAILABLE IN 'WORTHITE'
a new alloy steel with exceptional resistance to many acids, alkalis and slurries

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CHEMICAL PUMPS
A WIDE RANGE AVAILABLE

WORTHINGTON-SIMPSON LIMITED NEWARK NOTTS

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